Heating Piping & Air Conditioning

NOVEMBER 1958

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. . . for Consulting Engineers • Mechanical (Heating, Piping, and Air Conditioning) Contractors • Engineers with Plants and Big Buildings

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for greater strength . . . easier assembly

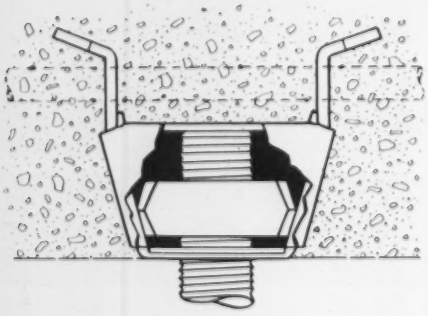
The new Grinnell Wedge Type Concrete Insert

Fig. 281

NEW design features give Grinnell's Wedge Type Concrete Insert (Fig. 281) greater load carrying capacity . . . 1200 lbs. for ⅝" and ¾" sizes, with a safety factor of at least 5 to 1.

Heavy gauge steel is die-formed into a wedge-shaped box housing. When load is attached to the inserted nut and rod assembly, ends of the elongated nut press on the wedge-slanted walls.

These walls, acting in compression with the concrete, provide strength unmatched in steel inserts of equal size.



Preassembly of the elongated nut on the rod makes quick assembly possible.

Installations can be made in quick time, too. Just a few turns of the rod tighten the nut rigidly in place. Slightly loosening the nut permits lateral adjustment along the full length of the slot, without fear of rod and nut falling out of the body.

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On your next project, specify Grinnell Concrete Inserts — either steel or malleable iron. Quality manufactured . . . *and priced right!* Grinnell Company, Inc., Providence 1, R. I.

CB-Universal Malleable Iron Concrete Insert (Fig. 282)

CB-Junior Malleable Iron Concrete Insert (Fig. 279)

Wrought Steel Concrete Insert (Fig. 280)

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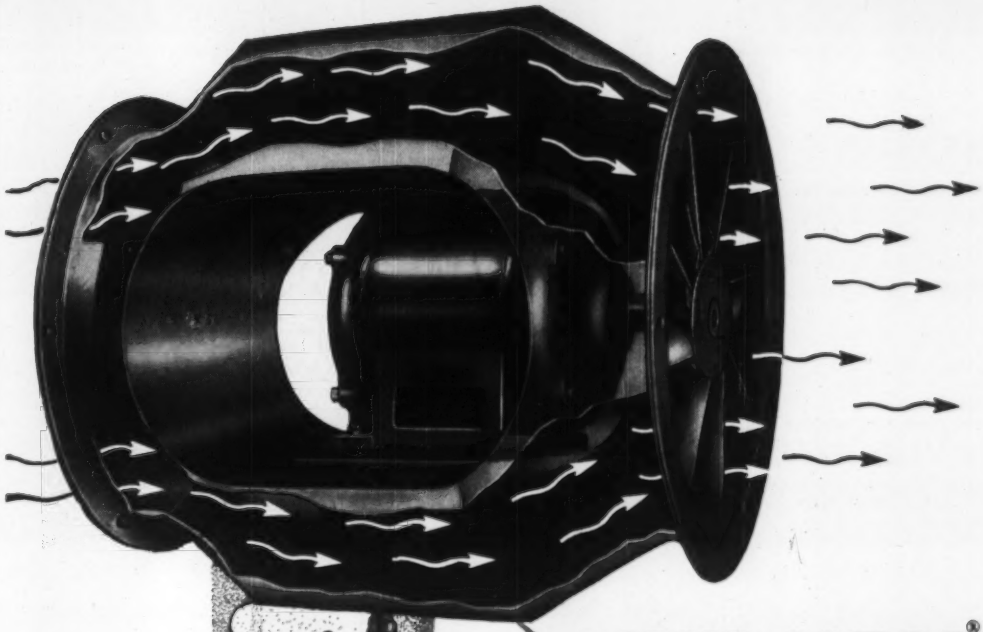

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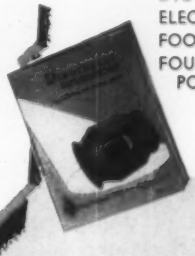

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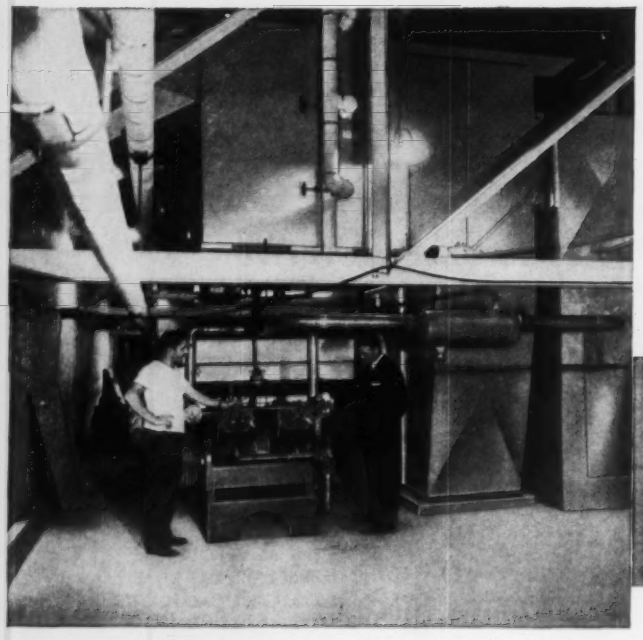

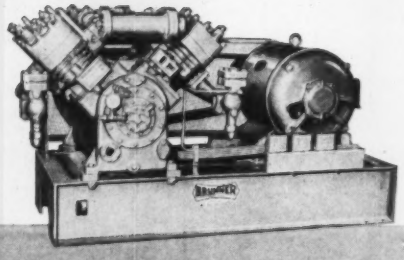

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Heating Piping & Air Conditioning

Vol. 30, No. 11

(With which is merged the Aerologist)

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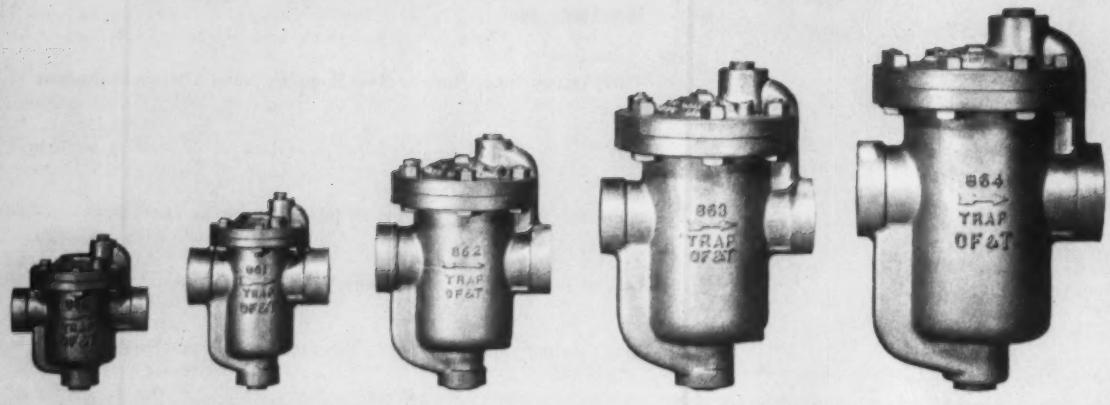
ARMSTRONG Open Float and Thermostatic Steam Traps



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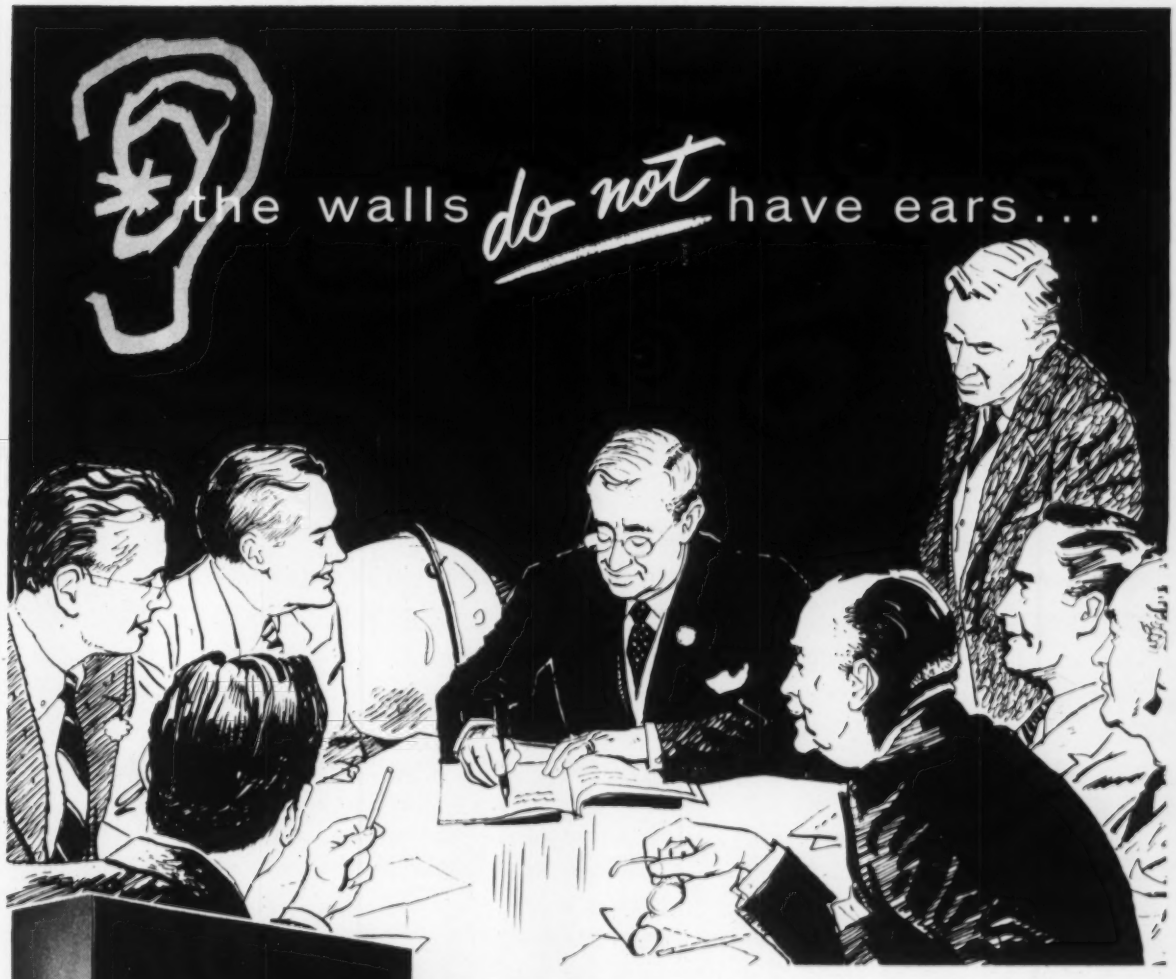

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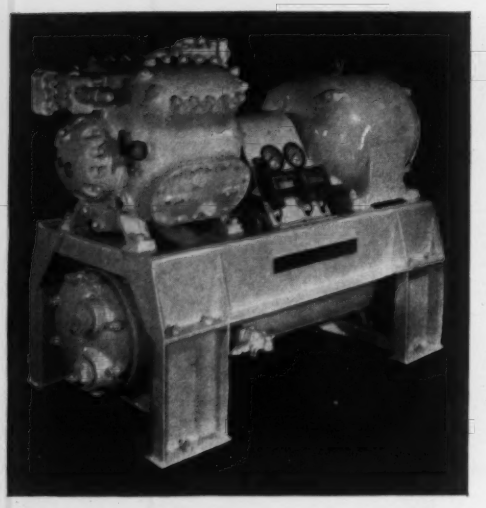

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10. **Forced feed lubrication.** Positive-displacement, self-reversing oil pump supplies excessive oil to main bearings, connecting rods and wrist pins.
11. **Crank case heater.** Standard equipment on all compressors.
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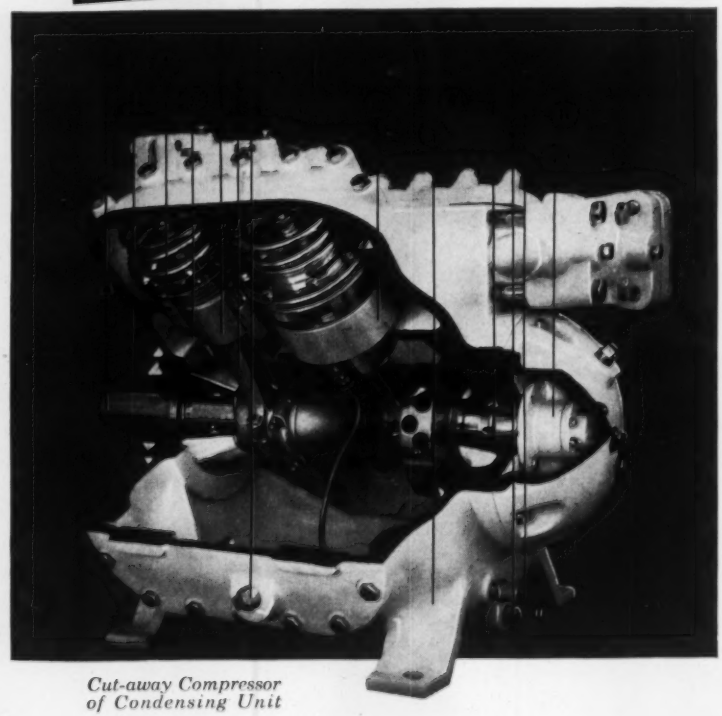
13. **Standard equipment.** Gas and oil equalization ports, magnetic plugs and oil sight glass.



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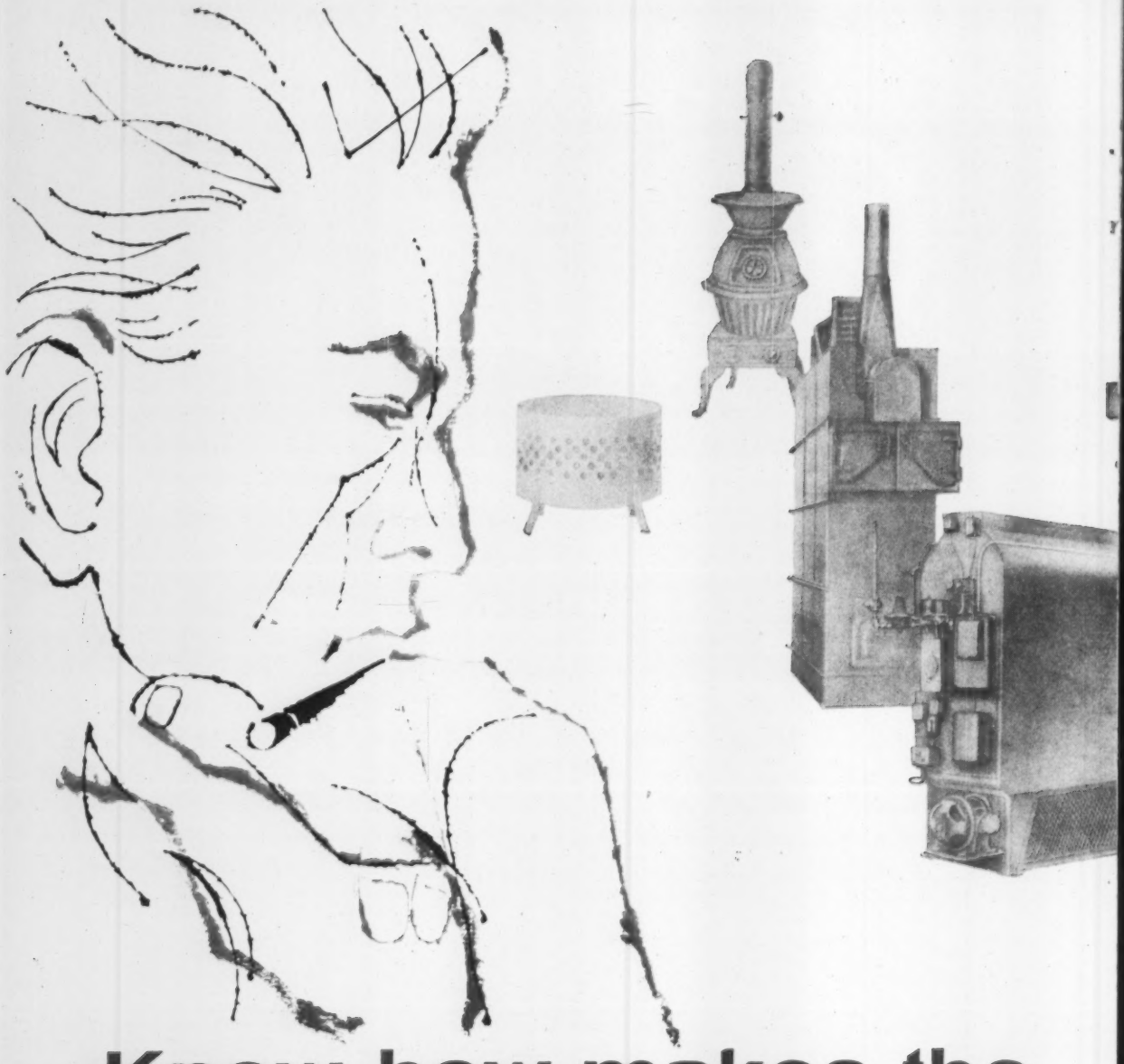

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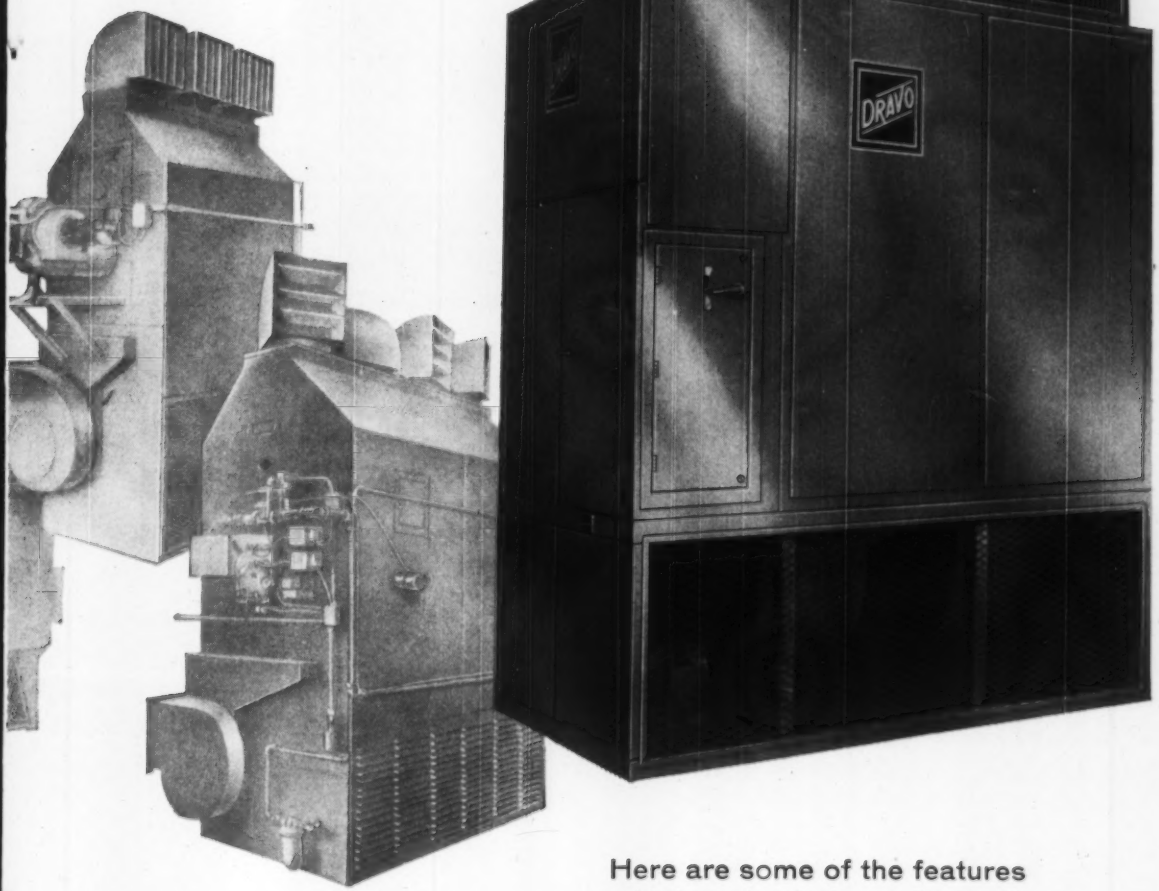

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The new Dravo *Counterflo* heater, developed by an exhaustive research program, represents an important advance in warm air space heating. Its "unitized" design, making each part integrate smoothly with the functioning of the rest, and the fact that each part was designed specifically for its function, makes the new *Counterflo* unique.

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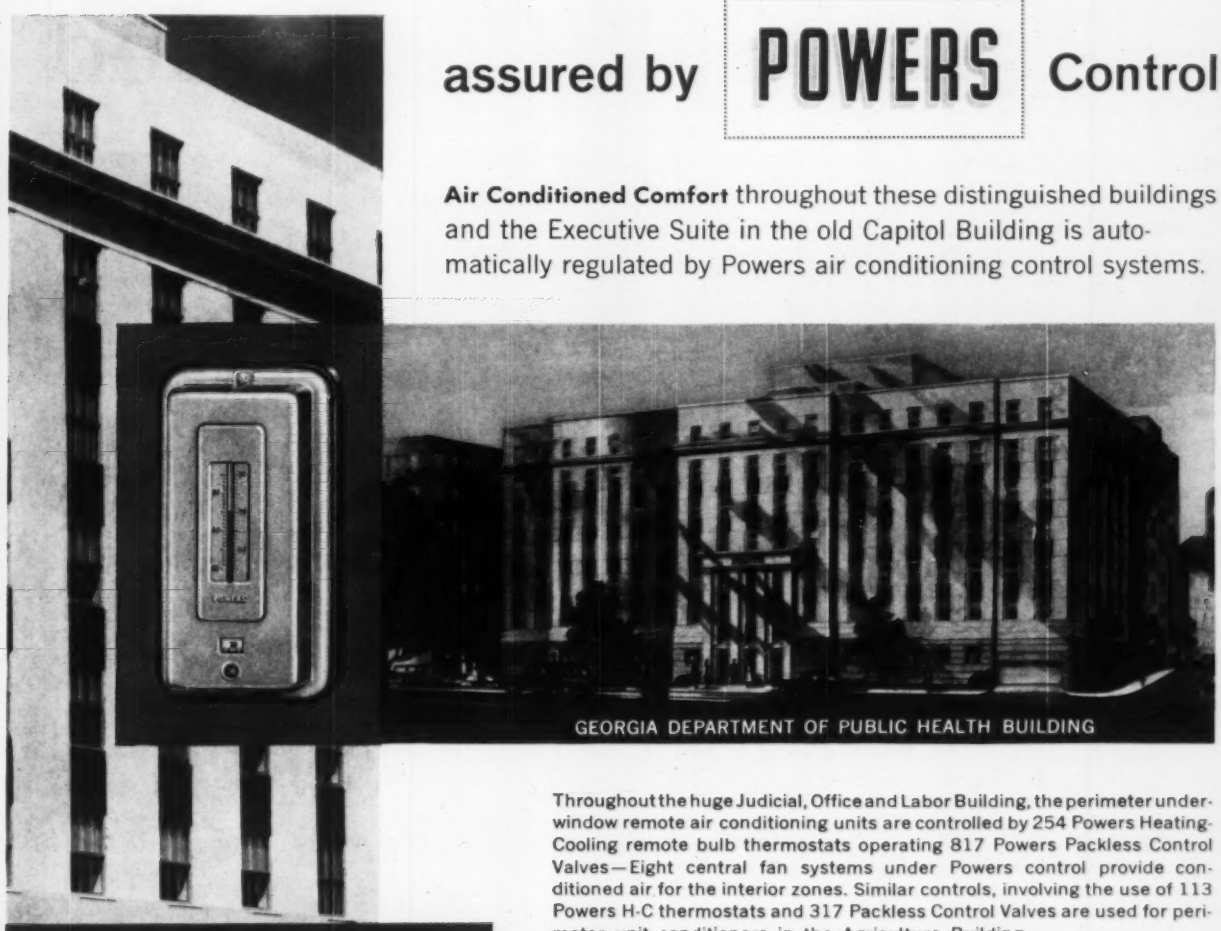

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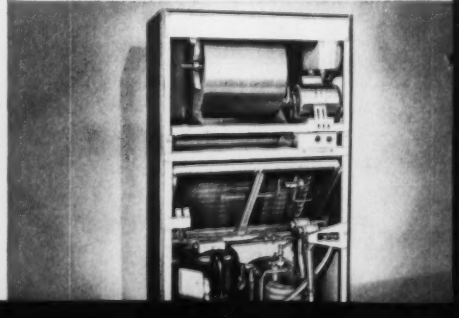

new styling for Climate Changer Units

3 to 30-ton packaged units — air or water-cooled — are easier to install, easier to service

Here's the new line-up of TRANE Self-Contained Climate Changers for 1959: new air or water-cooled units in a complete range of sizes from 3 to 30 tons. And they're beauties! New, modern styling, clean, classic lines, smaller dimensions make them blend with today's office and store design. And, of course, these new units are engineered to the same rigid specifications that have made TRANE a leader in big building air conditioning systems. They're easy to install, too, with just a few simple piping and wiring connections. Extra rugged construction makes them easy to ship and to handle on the job. So for your next "packaged" cooling job, make it a TRANE Self-Contained Climate Changer! Call your nearby TRANE Sales Office for complete facts on these new Climate Changer units—or write directly to TRANE, La Crosse, Wisconsin.

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- **Easy to service**—All components easily accessible from front panel. Removable refrigeration cycle can be serviced in field, or entire unit may be easily removed for in-shop repair or exchange.
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HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

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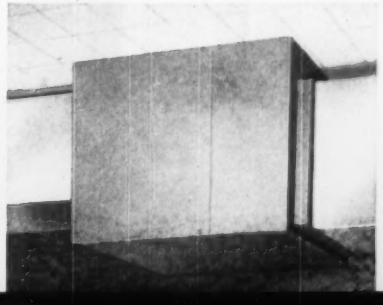
SCRANTON MFG. DIV., SCRANTON, PA. • CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA, LIMITED, TORONTO • 37 U. S. AND 15 CANADIAN OFFICES

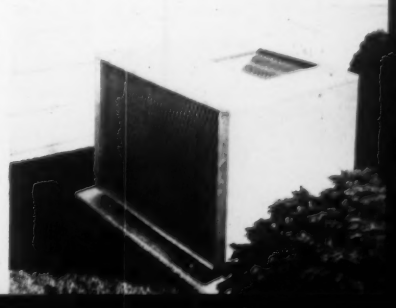
There's a Trane Climate Changer unit to cool any home, store or office!

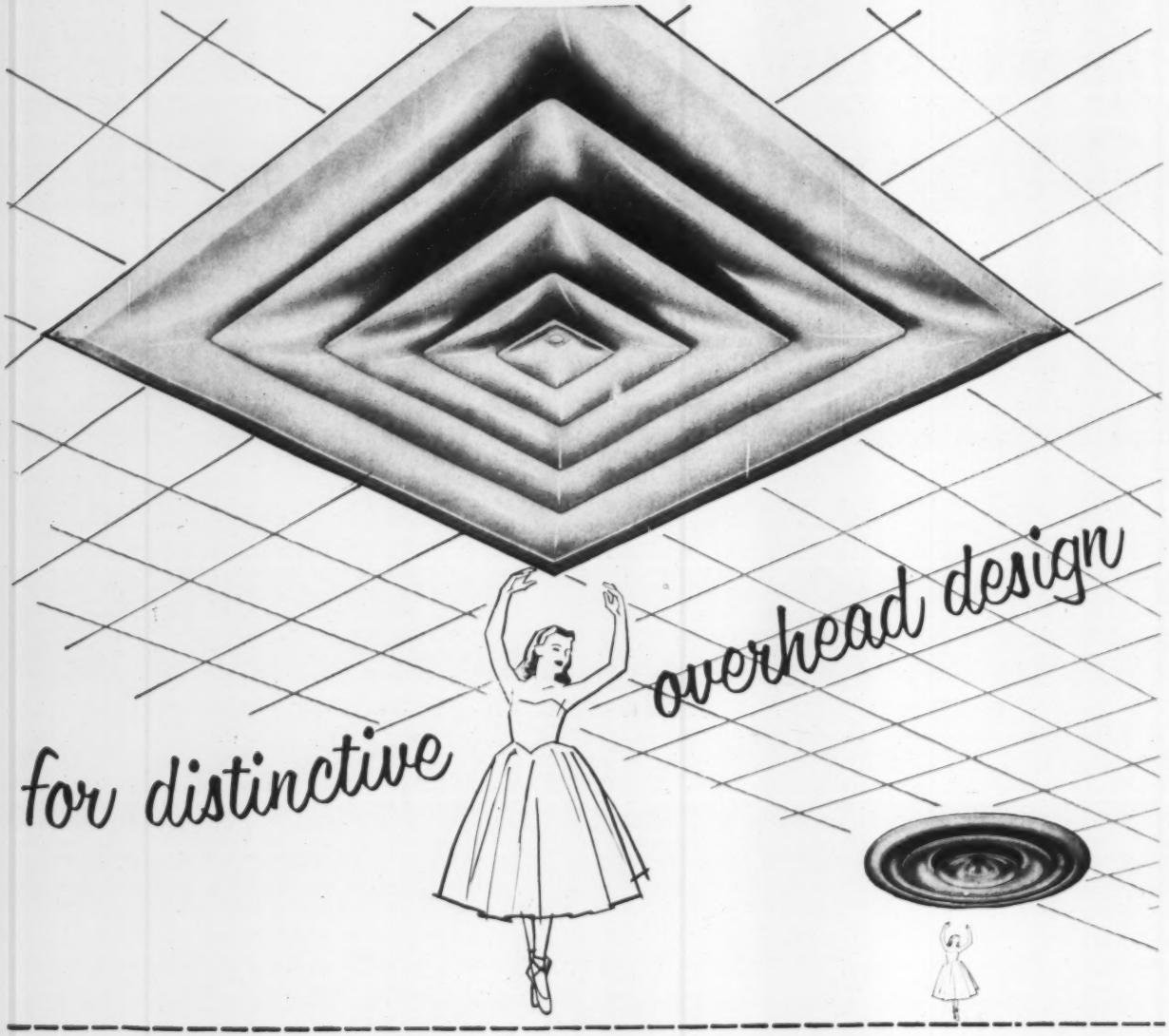
Heat and cool with this new Climate Changer combination unit. Warm air furnace in both oil and gas-fired models . . . complete range of sizes and types. Cooling section available in 2, 3 and 5-ton capacities.

Save space with this compact Fan-coil Climate Changer! Tucks away in attic, closet, utility room—or may be installed behind partition or under ceiling. Provides crisp, cool air for store, home or office. 2, 3 or 5-ton.



No water needed! These TRANE Climate Changers are air-cooled, eliminating water supply and disposal problems. Compact condensing unit is located outside the home or building.





CEILING DIFFUSERS

designed by **TITUS**

● SUPERB ULTRA MODERN STYLING

...These new ceiling diffusers give any room a dignified "room of tomorrow" look! All Titus ceiling diffusers—regardless of type—size—or shape—are so styled and proportioned that they blend harmoniously with each other and with room surroundings.

● SUPERIOR DIFFUSION PERFORMANCE

...New exclusive *curved contour cone design*—plus extreme adjustability—make these outstanding precision air diffusion outlets EQUALLY EFFICIENT FOR HANDLING EITHER COOLED OR HEATED AIR.

● UNIFORM APPEARANCE

...Regardless of air pattern setting—Titus Ceiling Diffusers always present a uniform appearance because 3 center cones move in unison and retain same relative position.

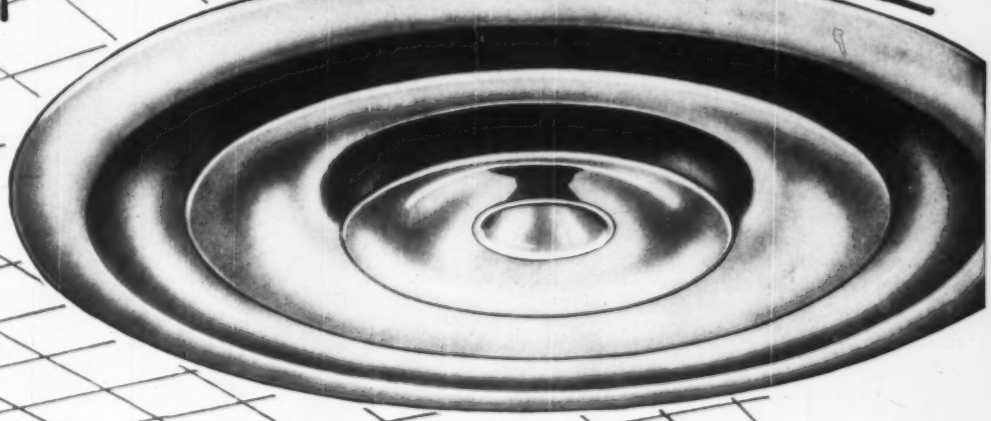
● SIMPLE TO INSTALL-ADJUST

...Ingenious spring lock arrangement for quick, easy installation or removal—saves time and labor. Adjustable at the factory—or on the job. On Titus adjustable round diffusers, simply turn small center cone to adjust to any air pattern.

● A COMPLETE LINE

...Titus Ceiling Diffusers are available in round, square and half round models in all standard sizes. Rigid steel construction—beautiful metalescent aluminum finish. Also a complete line of accessories—including ceiling cones, radial volume control dampers and plaster mounting rings.

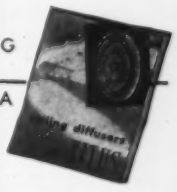
...specify the New Complete Line



TODAY'S OUTSTANDING AIR CONDITIONING ACHIEVEMENT

FOR HANDLING OVERHEAD AIR Gracefully WITH PRECISION

FREE CATALOG



TITUS MFG. CORP. WATERLOO, IOWA

Gentlemen: I am interested in full details (engineering data, prices) on your new complete line of Ceiling Diffusers and Accessories. RUSH NEW, FREE CATALOG.

Name

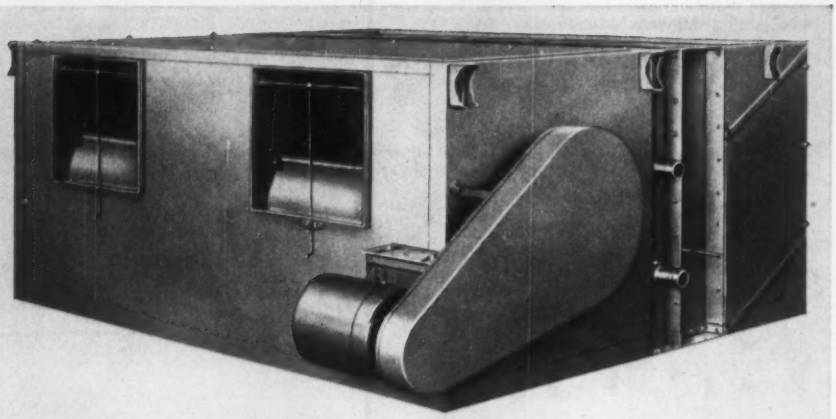
Company

Address

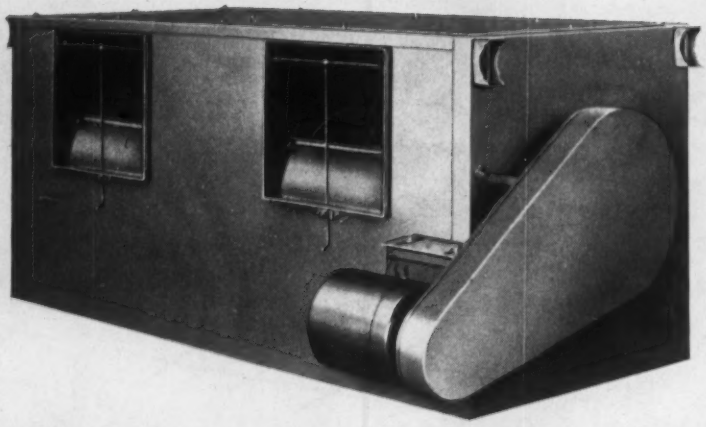
City State

NOW! AMERICAN BLOWER

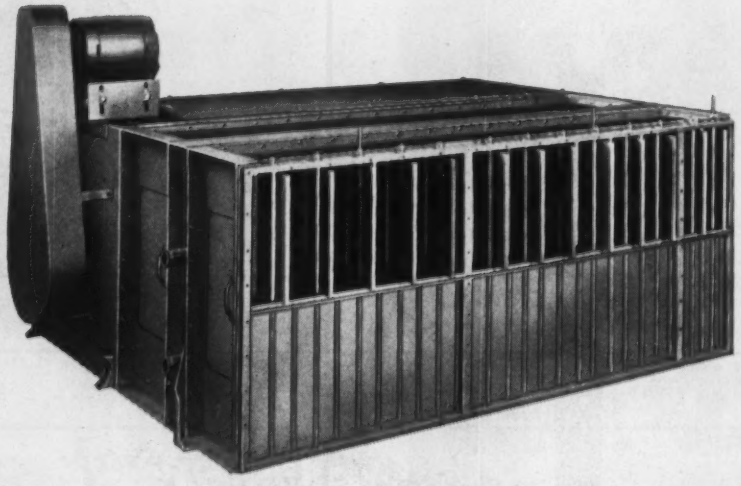
Heating and Ventilating Unit — Type V gives complete coverage of central-station heating and ventilating requirements. Steam or hot-water heating; large-volume, extra-quiet Sirocco Fans, for adequate heating and for ventilation. Ideal for offices, auditoriums, factory areas, gymnasiums, laboratories, schools and stores. Bulletin 8927.



Lineflow Ventilating Unit — Type L is a quiet, compact air handling unit for commercial and industrial uses. Designed for filtered air supply; fume and foul-air exhaust; air-conditioning zone distribution; and non-fouling kitchen and laboratory hood exhaust. Bulletin 8927.



Multi-Zone H & V Unit — Type VB provides individual zone control of temperature from a single central unit. Utilizes a "blow-thru" arrangement with individual zone dampers at the discharge end. Typical applications: schools, laboratories, offices and stores. Bulletin 8927.



DESIGNS NEW FLEXIBILITY INTO . . .

Heating and ventilating systems tailor-made with standard units

Sectional construction of basic components provides the required capacity, at savings in time, money and space!

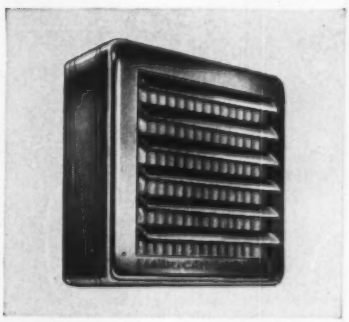
Want the efficiency and operating economy of a "tailor-made" heating or ventilating system? Need the lower initial installed cost of pre-engineered, "ready-made" components? Build around one of these three new H & V Units by American Blower!

American Blower Heating and Ventilating Units offer broad capacity coverage, with eleven sizes to handle from 600 to 66,000 cfm. New flexible design and sectional construction give a bigger selection of efficient combinations and space-saving arrangements to fit your requirements.

Units, coils and accessories assemble into a custom system at a packaged price. For example, there are eight unit arrangements based on fan rotation and discharge; four types of heating coils in a variety of arrangements with either top or bottom by-pass; and accessories such as filter boxes, face and by-pass dampers, damper-mixing boxes, and floor-base combinations.

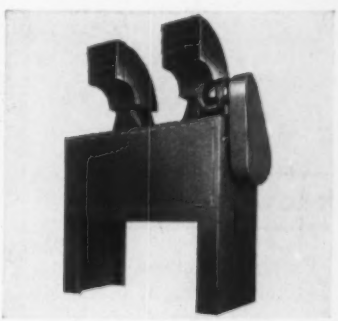
Every American Blower H & V component is precision-made for fast mounting and low-cost installation. Units are easy and economical to maintain and service because motors, drives and bearings are externally mounted, easily accessible. For full details, send for Bulletin 8927.

Remember: When you specify American Blower, you get equipment that's designed, engineered and manufactured to work together . . . *plus* one-source responsibility for its performance. Branch offices in 73 cities offer local product help or nationwide sales-service coordination. American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.



Venturafin® Unit Heaters—for steam or hot water. Quiet; adjustable louvers. Horizontal or vertical. Bulletin 9017.

Cabinet Heaters—attractive, quiet. Models for all applications. Steam, hot water; to 1860 cfm. Bulletin 9617.



Industrial Unit Heaters—high-capacity, quiet. Universal cowls. Steam, hot water; 7 sizes, 4 arrangements. Bulletin 7727.

*American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.

American-Standard Products

AMERICAN-Standard

AMERICAN BLOWER DIVISION

Acme . . . the **practical** approach to air conditioning

RG 3 to 30 tons

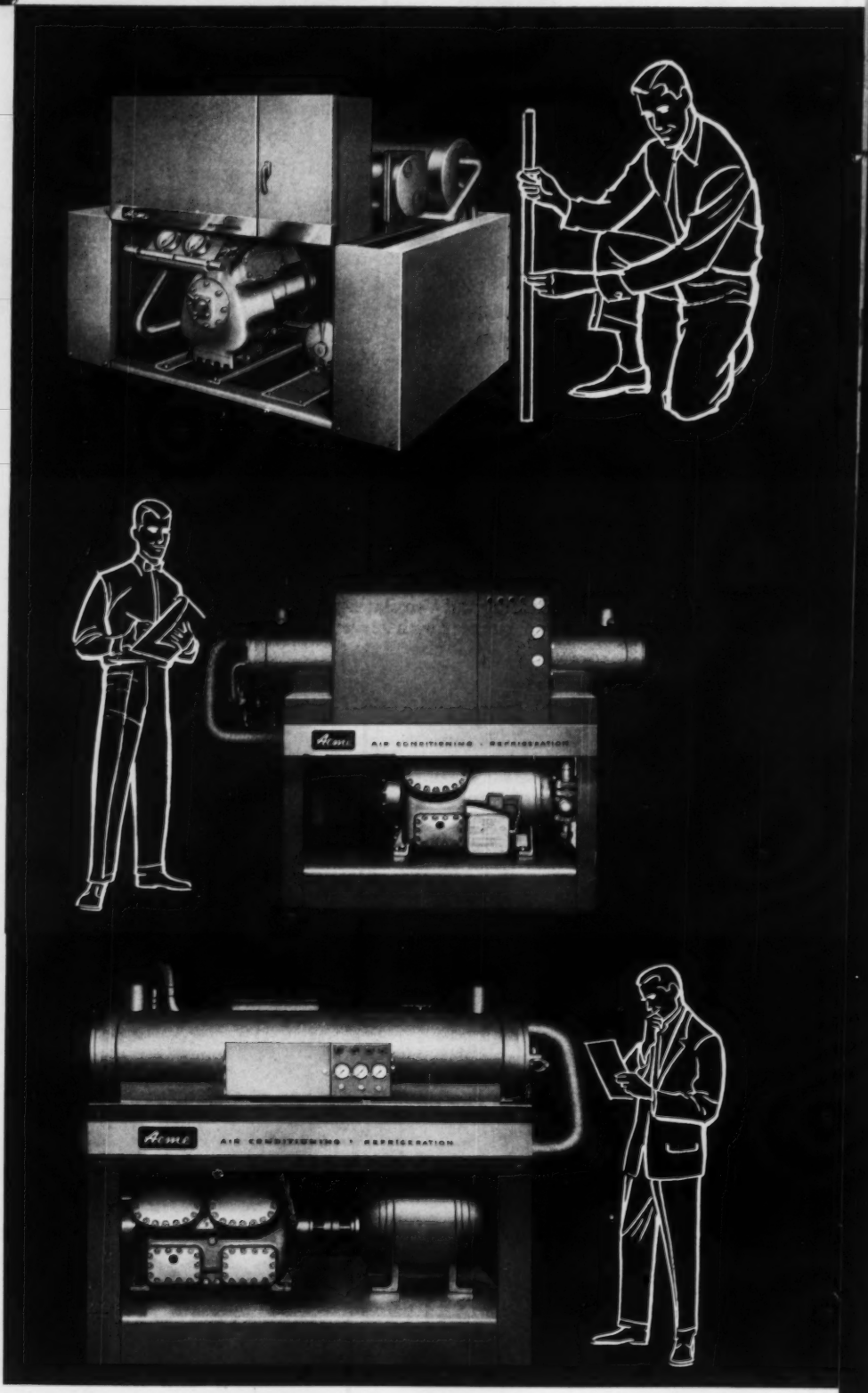
Completely wired and piped unit including controls, circulating pump and operating charge. Hermetic compressor. Extremely quiet in operation. 8 models.

HE 20 to 60 tons

Completely assembled from matched components including all internal wiring and piping, controls and gauges. Hermetic compressor. Operates smoothly and quietly. 6 models.

DE 20 to 125 tons

Factory assembled from matched components, delivered complete with motor coupled to direct drive compressor, controls mounted and wired, and holding charge of refrigerant. Starters optional. Quiet, compact, reliable. 9 models.



A full NEW line of high performance Acme WATER CHILLERS

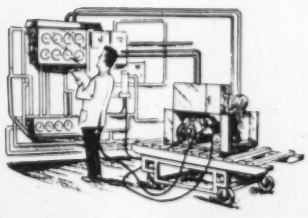
SMALLER • LIGHTER • EASIER TO USE

Here is a completely new line of Acme packaged water chillers, in a full range of sizes, which pack more capacity in less space than ever before. Size has been cut as much as 50%, weight as much as 30%, and costs have been reduced, too. Now you can have the simplicity of a completely factory-assembled packaged unit . . . the rugged reliability for which Acme equipment has always been known . . . and the smooth, quiet performance that you have always wanted—all wrapped up in a smaller, lighter, lower cost package.

These great new Acme packaged water chillers mean that you can save building space . . . cut structural requirements . . . slash installation costs while using top quality Acme equipment.

Complete Acme Systems

In addition to this great new line of packaged water chillers, Acme offers a complete range of water-saving and cooling distribution equipment for both wet and direct expansion systems. Get the full story on the new Acme Packaged Water Chiller line and on other components for a complete Acme system. Call your nearby Acme sales engineer or write directly to the factory.

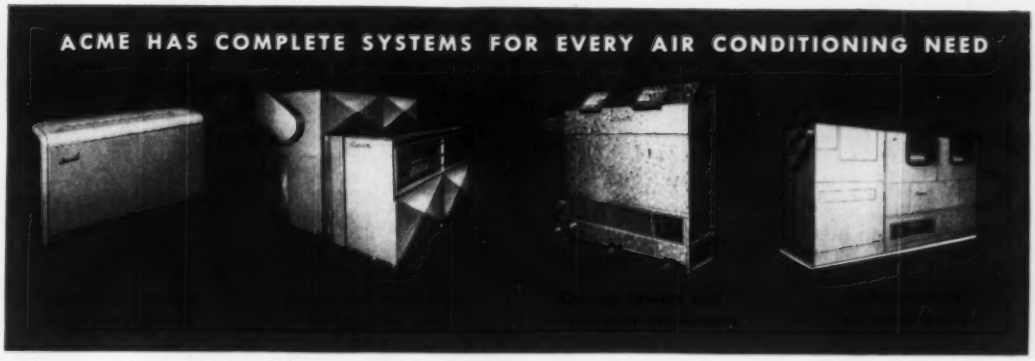


EVERY UNIT TESTED AND CERTIFIED

Every Acme packaged water chiller is tested under operating conditions before shipment. Performance data is recorded on the most modern testing instruments and every machine carries a certificate guaranteeing that the unit has performed according to specifications.

Acme
INDUSTRIES, INC.
JACKSON, MICHIGAN

Manufacturers of quality air-conditioning and refrigeration equipment since 1919.



COPPER

simplifies plumbing in big addition to Children's Hospital, Pittsburgh

ARCHITECT'S RENDERING of Children's Hospital Addition (foreground) at Pittsburgh. *Architect*: Alfred D. Reid Associates, Pittsburgh. *Consulting Engineer*: J. A. Murray, Pittsburgh. *Plumbing Contractor*: Sauer, Inc., Pittsburgh.

MAKING A SOLDER JOINT on an 8-inch copper soil and waste line – the largest size used in the drainage system. Solder-joint connections are one of the important reasons why copper tube systems are so much easier and faster to install.

TESTING A VALVE on the hot-water supply system. Other copper tube lines in view are part of the sanitary drainage system, ranging in size from 1½ inches to 4 inches. Because connections are easily made, even in tight quarters, the lines can hug the ceiling.

SOME 70,000 pounds of Anaconda copper tube were used in the sanitary drainage system, hot- and cold-water lines, oxygen, vacuum, and compressed-air lines of the addition to Children's Hospital in Pittsburgh.

Copper plumbing provides the advantages of easier, faster installation, with additional economies in design and construction made possible by the lighter weight of copper tubes and the trim, space-saving, solder-joint fittings. Equally important, however, are the long-range benefits. Copper tube systems last longer, require less maintenance than systems of other materials.

Everyone benefits with all-copper plumbing. Architects have greater freedom in design to locate bathrooms and utilities where desired without sacrificing useful space. Contractors report that installation time has been reduced up to one-half – and their men prefer working with copper tube. Owners get plumbing that lasts – costs little to maintain.

Anaconda Copper Tubes are available in all standard wall thicknesses – Types K, L, M, and DWV (Copper Drainage Tube) – through plumbing wholesalers. There's a full line of Anaconda wrought and cast solder-joint fittings. For more information on ALL-COPPER plumbing, write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

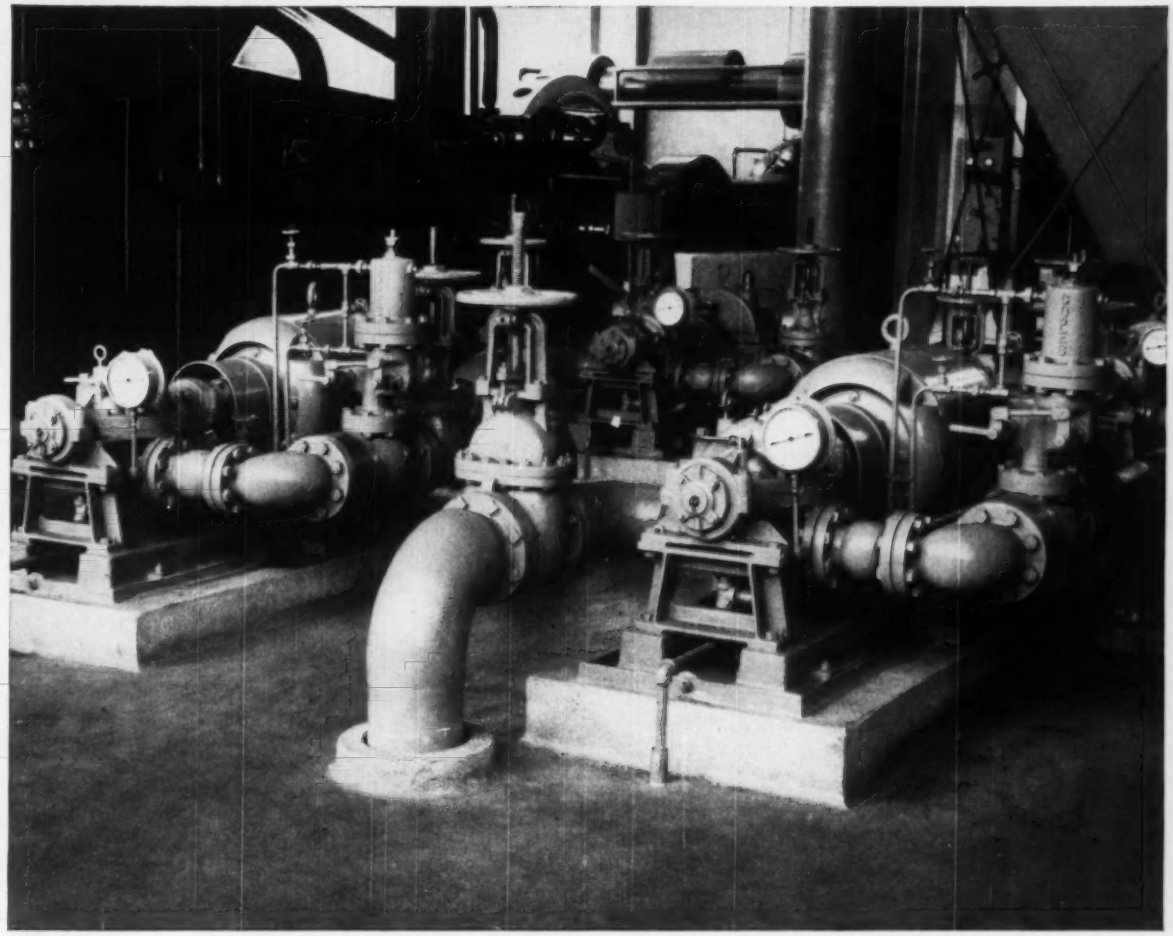
5809

ANACONDA®

COPPER TUBES AND FITTINGS

Products of **THE AMERICAN BRASS COMPANY**

Available through Plumbing Wholesalers



"Buffalo" Type RR Pumps on boiler feed at a large auto plant

"BUFFALO" – THE PUMPS THAT DON'T MIND BEING IN HOT WATER AND UNDER PRESSURE!

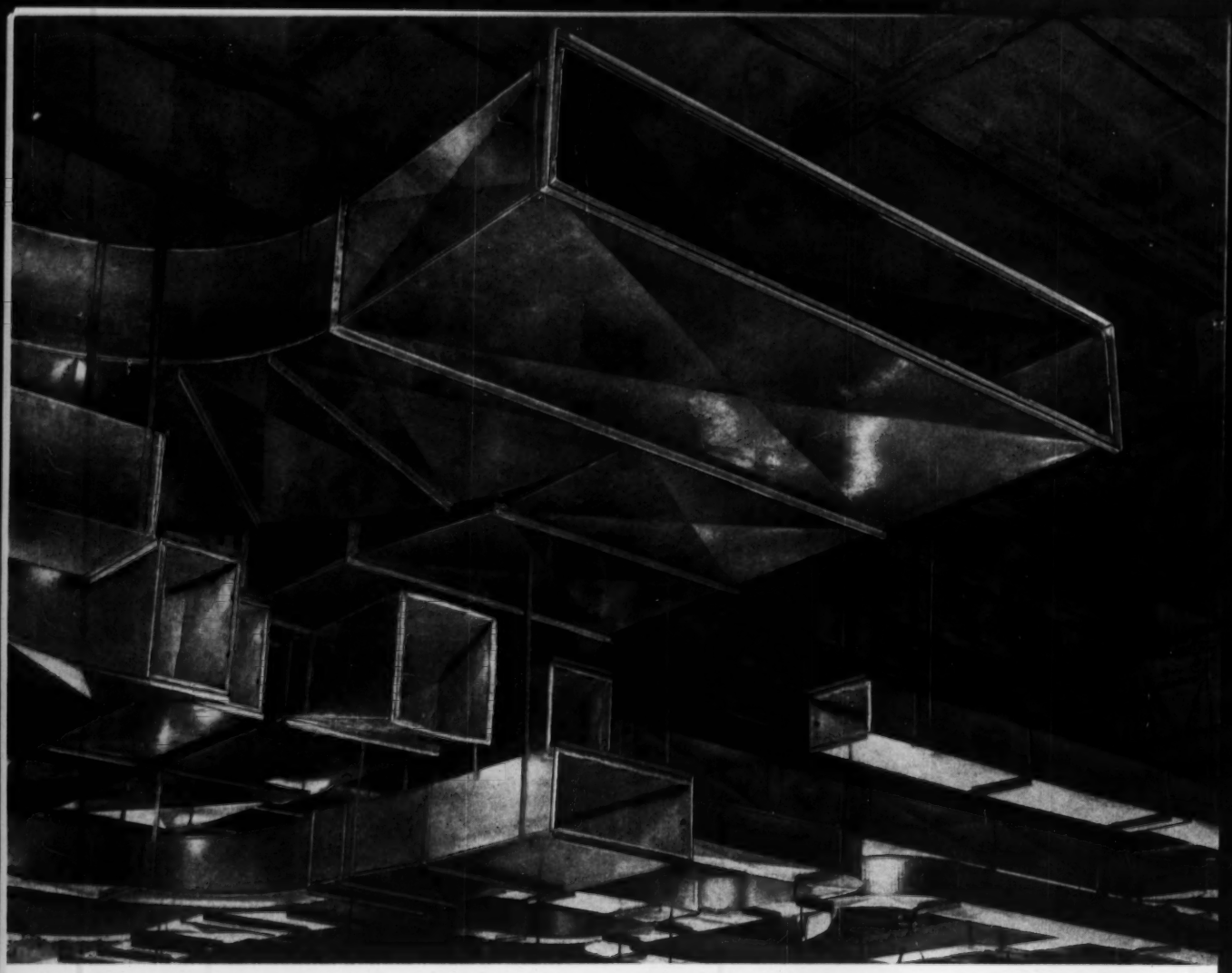
In selecting boiler feed pumps of both peak efficiency and year-after-year durability, under pressure, pick the make with the 80-year record for these characteristics — "Buffalo". This long experience in designing and building centrifugal pumps for industry has resulted in present-day "Buffalo" Pumps with every feature for maximum delivery at least power input — and for continuous service with negligible maintenance.

"Buffalo" Type RR two-stage and four-stage pumps have the typically efficient, balanced "Buffalo" impellers — the oversize bearings and shafts — the rugged casings with simply formed water passages and deep 8-ring stuffing boxes. Write for Bulletin 980 and see why we say there's no better buy!

Boiler feed pumps for pressures to 500 psi

BUFFALO PUMPS
Division of Buffalo Forge Co.
171 MORTIMER STREET, BUFFALO, N. Y.
Canada Pumps, Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



All ductwork was fabricated in Dallas by the Straus-Frank Company.

Ductwork made from USS Galvanized Steel installed in two Dallas Mercantile Buildings

It took 285 tons of galvanized steel sheets to make ductwork to air-condition the recently constructed Mercantile Dallas Building and the eight floors added to the Mercantile Continental Building in Dallas, Texas. An unusual inter-building heating and refrigerated-water air-conditioning system ties these structures to the older Mercantile Securities and Mercantile National Bank Buildings.

About 80% of the ductwork was made from USS Galvanized Steel Sheets. They were selected because of their excellent strength, formability, and zinc adherence.

USS is a registered trademark

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
American Steel & Wire—Cleveland
United States Steel Supply—Steel Service Centers
United States Steel Export Company

USS United States Steel

new SUPER /AIR-VAN®

in FIBERGLAS

INHERENTLY QUIET
SONOSOLVE HOOD
NEVER NEEDS PAINTING
CORROSION RESISTANT
LIGHTWEIGHT
STRONGER THAN STEEL
LOW INITIAL COST
LOW SILHOUETTE
PATENTED SCROLL DESIGN
PATENTED AIR SEAL OFF

AVAILABLE IN ANY COLOR

The Gallaher Company 4108 Dodge Street Omaha, Nebraska

More than 100,000 Gallaher Air-Vans Have Been Installed.

*TM Owens-Corning Fiberglas Corporation

U. S. Pats. 2188741, 2526290 Pats. Pending

You get positive protection on P-K copper-lined water heaters with P-K's exclusive

Vaco-Valve

When you specify P-K Copper-Lined Heaters you specify Vaco-Valve protection.

Every P-K copper-lined heater carries the Vaco-Valve as standard original equipment. Every copper-lined water heater of any make should be protected with this P-K engineered vacuum breaker.

A sudden water demand can create a vacuum in any water heater. Coupled with the resultant insurge of cold water, this can result in strains in the lining. To guard against such damage, P-K engineers developed the Vaco-Valve.

P-K Vaco-Valves should be specified on *every* copper-lined heater. They justify the extra cost in the protection afforded copper linings. Of course, the Vaco-Valve is standard equipment on all P-K copper-lined heaters—at *no* extra cost.

Always specify P-K copper-lined heaters and get the advantage of all these exclusive design and construction features:

Process water comes in contact only with copper or copper silicon • Rolled expansion joints every twelve inches • Easy accessibility of U-tubes • Tested for 8 hours, at ten inches of vacuum, to assure against leakage of copper lining • Hydrostatically tested at 250 psi for 12 hours.

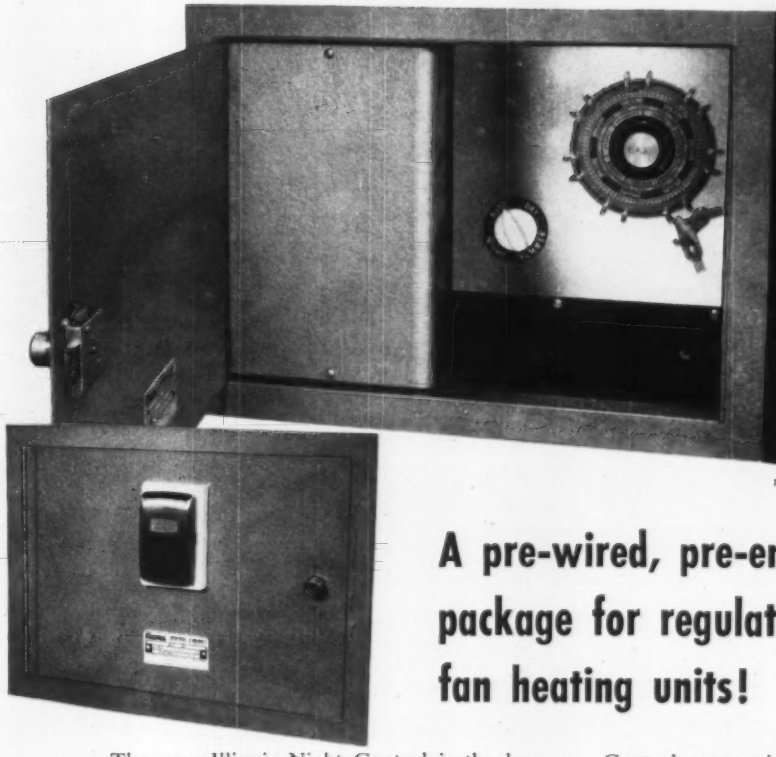
Get the latest and most complete data on copper-lined storage water heaters. Write for P-K Data File 16. The Patterson-Kelley Co., Inc., 2111 Warren Street, East Stroudsburg, Pa.

3

Patterson Kelley
Water Heater Division

Storage Water Heaters • Instantaneous Heaters • Convertors • Freon Water Chillers • Water to Water Exchangers

Now! Lower operating costs with new



illinois NIGHT* CONTROL

*Or anytime!

A pre-wired, pre-engineered package for regulating motor-driven fan heating units!

The new Illinois Night Control is the low-cost answer to effective off-hour control of motor-driven fan heating units. Perfect for heating or air conditioning systems in schools (including unit ventilator systems), churches, industrial plants, commercial buildings, shopping centers—any place where it's desirable to automatically adjust temperatures during unoccupied periods. No more expensive on-the-job wiring — Illinois Night Control contains everything in one compact, pre-wired cabinet.

HERE'S HOW IT WORKS — Illinois Night Control automatically shuts off heating unit fan motors—singly or in groups—when they are not needed during unoccupied periods. During these periods the area is heated by convection only until space temperature drops below the desired level. The control then starts the fan which operates until the proper temperature is reached. It's as simple as that!

Illinois Night Control works with normal temperature regulation to reduce needless system operation.

illinois ENGINEERING

A product of Illinois Engineering Co.
2035 South Racine Ave., Chicago 8, Illinois
Division of American Air Filter Co., Inc.

MAIL COUPON FOR MORE INFORMATION

Illinois Engineering Company
2035 South Racine Avenue
Chicago 8, Illinois

Please send me Bulletin No. 570 describing new Illinois Night Control.

Name _____

Firm _____

Address _____

City _____ State _____

Sarco Type H Radiator Trap

Sarco Spring-Packless Steam Radiator Valve

Sarco Float-Thermostatic Steam Trap

Sarco SB Strainer

Sarco TR 50-21 Temperature Regulator

These Sarco Products

give these New York City Schools reliable heating systems . . . economically

WILLIAM F. GRADY VOCATIONAL HIGH SCHOOL, New York. Katz, Waisman, Blumenkranz, Stein & Weber, Architects. Raisler Corporation, Heating Contractor. Benjamin L. Spivak, Engineer.

JUNIOR HIGH SCHOOL 142, New York, New York City Board of Education, Bureau of Construction, Architects and Engineers. Daniel J. Rice, Inc., Heating Contractor.

NEW YORK SCHOOL OF PRINTING, New York. Kelly & Gruzen, Architects. Afgo Engineering Corporation, Contractor. Jaros, Baum & Bolles, Engineers.

JUNIOR HIGH SCHOOL 211, New York. Lloyd Morgan & Eugene V. Meroni, Architects; Harry P. Jaenike, Associate. Daniel J. Rice, Inc., Heating Contractor.

SHEEPSHEAD BAY HIGH SCHOOL, New York. Holden, Egan Wilson & Corser, Architects. Raisler Corporation, Heating Contractor. Slocum & Fuller, Engineers.

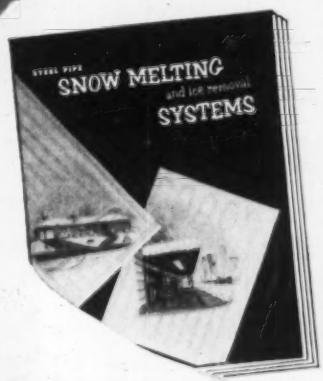
In all five of these brand new schools, designed and constructed to the highest standards of the New York City Board of Education, all five of these Sarco products shown above are used to assure trouble-free heating systems. High-quality Sarco steam traps, valves, strainers, temperature controls, and other heating specialties assure dependable system performance – with extremely low maintenance costs.

FOR DETAILS on cost-saving temperature controls, steam traps, or heating specialties . . . or for engineering information . . . contact your Sarco-Sarcotherm sales representative, or write

6692-B

SARCO
COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES



Get pipe sales snowballing...

with this **FREE BOOKLET**

on snow melting

Now is the time to tell your customers about SPANGRID steel pipe snow melting systems. This free booklet, "Snow Melting Systems," explains to your customers the benefits of snow melting, the cost, its installation methods and maintenance.

SPANG is backing up your sales effort with ads in such nationally-circulated magazines as *Purchasing* and *Factory Management & Maintenance*. This promotion tells your customers why they need SPANGRID snow melting systems . . . for their driveways, loading docks, ramps and walks.

SPANGRID is especially suitable for snow melting, refrigeration and radiant heating systems. It is produced under strict *quality-controlled* methods, and every shipment is thoroughly inspected to insure you and your customers *top-quality* performance.

GET YOUR FREE BOOKLETS TODAY

by calling your regional SPANG Sales Office. Order as many as you can use. Mail them to your prospects with your personal sales message. Start selling NOW.

SPANGRID* STEEL PIPE

* REG. U.S. PAT. OFF.

SPANG-CHALFANT

DIVISION OF THE NATIONAL SUPPLY COMPANY

GENERAL SALES OFFICE: TWO GATEWAY CENTER, PITTSBURGH, PA.

District Offices and Sales Representatives in Principal Cities

Pipe Jobber: Familliam Pipe & Supply Co., Inc., Los Angeles. Builders: Edward K. Zukerman and Barney R. Morris, Beverly Hills. Plumbing Contractor: Fontana Plumbing Contractors, La Puente.

steel pipe for vents and drainage, gas and water lines

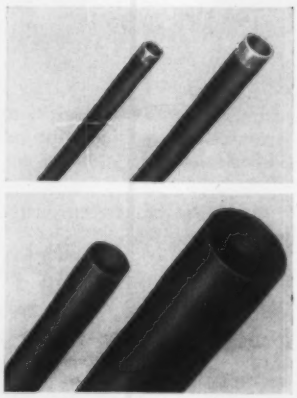
IN 500 CALIFORNIA HOMES —BETH-CO-WELD PIPE

Acre after acre of new-executive homes—that's the Grandview Palos Verdes community development, just south of Los Angeles.

And in each home, hundreds of feet of steel pipe—Beth-Co-Weld steel pipe, low in cost, long in service.

Used for drainage lines, for ventilation, and for gas and water lines, steel pipe combines the greatest strength and serviceability with the lowest cost. And for an added plus: Beth-Co-Weld pipe is made of top-quality steel by the continuous butt-weld method. That's why it's so uniform, so easy to work, and so thoroughly dependable.

When you're ready to build, consider the advantages of steel pipe . . . and specify Beth-Co-Weld.



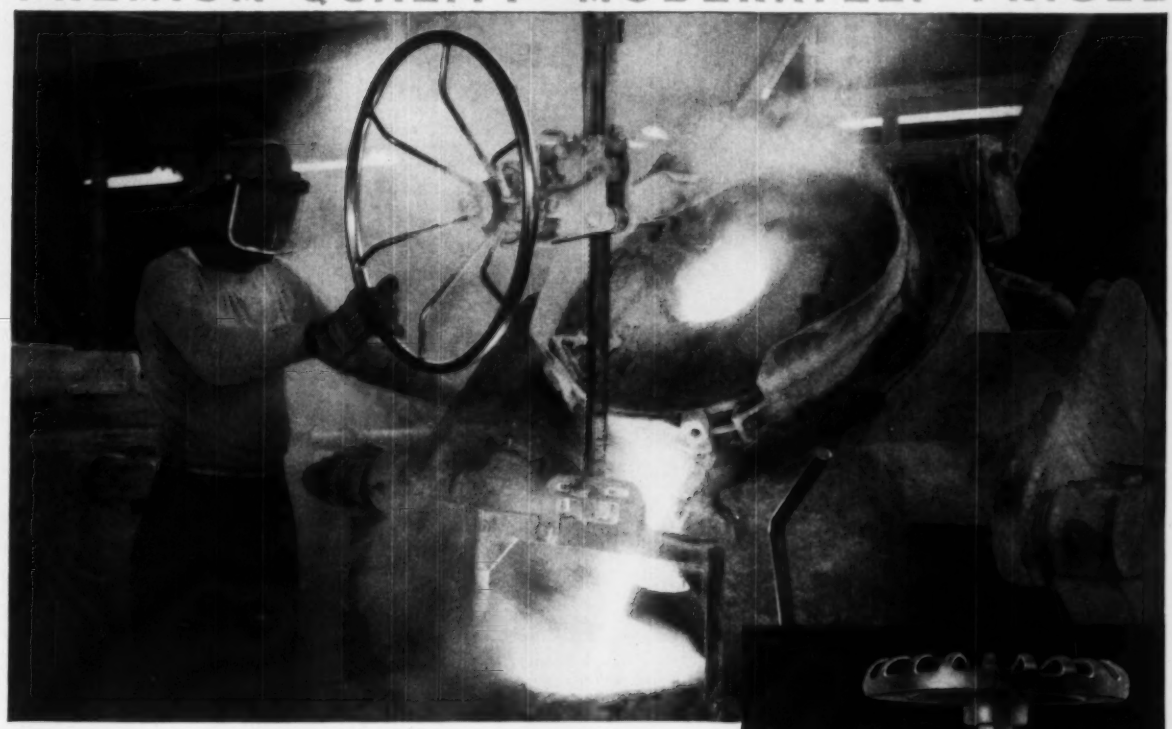
Bethlehem steel pipe is available in sizes from ½ in. to 4 in. in continuous butt-weld, and from 5 in., nominal, through 16 in. OD in electric resistance-weld. Before specifying, write for Bethlehem's new *Handbook of Tubular Products.* Address: Publications Dept., Bethlehem Steel Company, Bethlehem, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation, *Export Distributor*: Bethlehem Steel Export Corporation.

BETHLEHEM STEEL

BETHLEHEM STEEL

PREMIUM QUALITY—MODERATELY PRICED



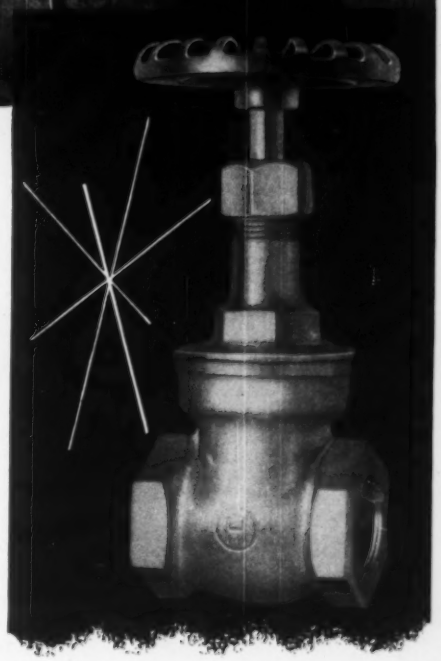
From virgin ingot to packaged valve-under one roof

At Hammond every step in the manufacture of bronze valves —from the melting of the certified bronze ingot down to final individual testing and packaging—is performed in one modern factory.

Each manufacturing step is conducted under rigorous controls to insure that every valve meets Hammond's reputation for quality second to none in the valve industry. Modern "automation" methods and high volume permit manufacturing economies which allow Hammond valves to be sold at moderate prices for valves of outstanding quality.

Hammond is one of the world's largest producers of bronze valves—and bronze valves are our only product. As such, they get the undivided attention of an outstanding engineering staff . . . are not relegated to a secondary position. Hammond engineers have developed over 550 different bronze valve designs . . . which means you can get a Hammond valve especially suited to your particular flow control requirements.

A new catalog No. 158, describes Hammond's complete line, contains valve number comparison charts and other engineering data. Write today to Hammond Brass Works, Hammond, Indiana.



Hammond Number 626 gate valve has rising stem, double wedge disc. Sturdily designed for heavy-duty industrial, commercial and original equipment application, to 150 lbs. steam, 300 lbs. w.o.g.

HAMMOND *BRITE-KOTE*® BRONZE VALVES

SPECIAL FITTINGS Need *NOT* Delay You

Entire interior and exterior surfaces of special stainless elbows for nuclear power plant are inspected with dye penetrant in search of microscopic surface imperfections. Elbows are 16" O.D. with 102° included angle and long tangent on one end.

Midwest Can Make *and* Deliver

An exclusive and flexible manufacturing process enables us to make welding fittings of any material available in plate that can be worked and welded. As plate is more readily available than pipe, in special materials and thicknesses, deliveries are much better.

Elbows with special included angles, special tangents, special wall thicknesses and of special materials are easily and promptly made. Closer tolerances are inherent in the Midwest process. Quality control always exceeds code requirements . . . can be as comprehensive as you need.

Whether or not you use specials, Midwest Welding Fittings will do a better job for you. Consult your distributor, or write us for new Bulletin 5801.

MIDWEST PIPING COMPANY, INC.

Main Office: St. Louis 3, Mo. (P. O. Box 433)

PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

SALES OFFICES:

Asheville—(Box 446, Skyland, N. C.) • Atlanta 9—72 11th St., N. E.
Boston 27—426 First St. • Chicago 3—79 West Monroe St.
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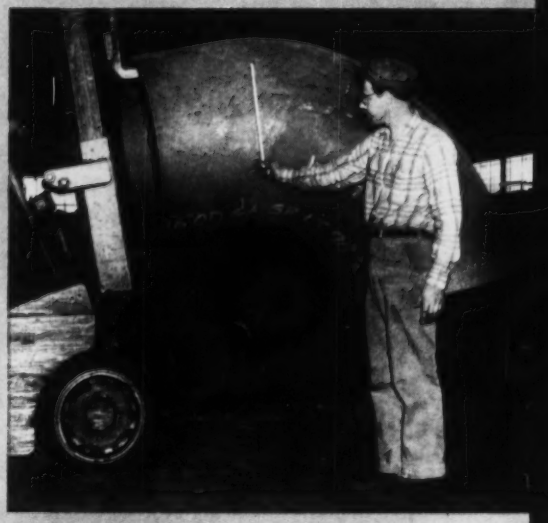
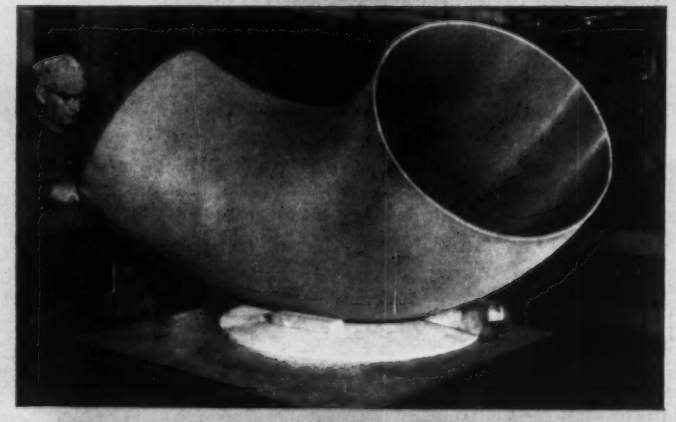
Los Angeles 33—520 Anderson St. • Miami 34—2103 Le Jeune Rd.
New York 7—50 Church St. • Pittsburgh 19—437 Grant St.
San Francisco 11—420 Market St.
St. Louis 4—1450 South Second St.
Tulsa—1640 E. 21st St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

Note the exceptionally long tangent on one end of this 36" O.D. 90° short radius elbow made of special carbon steel. Similar tangent could have been provided on other end if required.



18" O.D. x 1¼" wall 90° elbows (2¼% chrome ½% moly) being sized in compression by totally enclosing dies. The exceptional dimensional accuracy that results is possible only with the Midwest process.



Interior surface of 30" O.D. stainless steel welding elbow for liquid sodium nuclear system required a finish of 125 micro-inches or better.

8060

MIDWEST WELDING FITTINGS

IMPROVE PIPING DESIGN and REDUCE COSTS

Can you find the Pritchard LoLine cooling tower in this picture?

Chances are it will take more than a cursory glance to spot the Pritchard LoLine Cooling Tower in the picture. That's because it is low . . . hugs the roof inconspicuously . . . becomes almost a *part* of the building. It is particularly suited for use where architectural considerations are important.

Yet the Pritchard LoLine tower is a workhorse. Its sleek appearance takes nothing away from its performance. Available in capacities of 75 tons and up, it will handle most commercial and industrial cooling requirements with ease. Initial, operating, and maintenance costs are low, too.

So whether your main concern is aesthetics or performance, air conditioning or process cooling, commercial use or industrial use, there is a Pritchard cooling tower that will fit your needs to a "T."

For full information on Pritchard LoLine Cooling Towers, send coupon for informative 16-page bulletin.

J. F. PRITCHARD & CO.
OF CALIFORNIA
Dept. 108,
4625 Roanoke Pky., Kansas City 12, Mo.

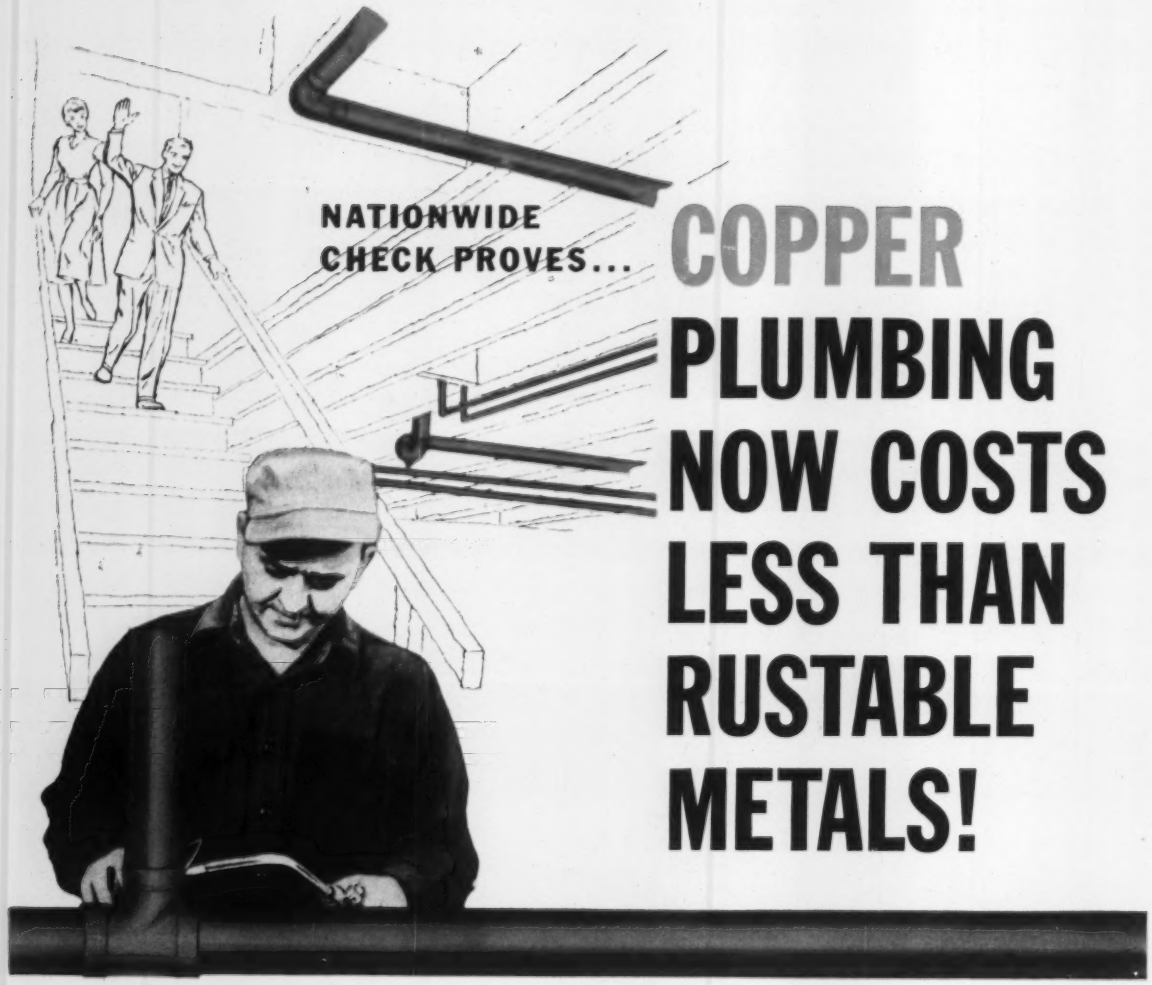
Please send Bulletin 5.1.902 on LoLine Cooling Towers

Name ..... Title .....

Firm .....

Address .....

City ..... Zone ..... State .....



NATIONWIDE CHECK PROVES...

COPPER PLUMBING NOW COSTS LESS THAN RUSTABLE METALS!

HERE ARE EXACT FIGURES:

City	Over-All Cost of Copper Tube, Water and Drainage	Over-All Cost Using Other Metals	
Waterbury	$537.05	$621.16	Copper $84.11 less
Providence	658.00	665.00	Copper 7.00 less
Detroit	725.91	737.74	Copper 11.83 less
San Francisco	432.65	438.49	Copper 5.84 less

THERE YOU HAVE IT! When you figure water and drainage systems, why not figure on the best? Copper costs less...as shown in the four cities listed above.

THE RESULTS ARE IN! Plumbing Contractors from coast to coast—in key cities—figured the cost of copper water lines and drainage against other so-called "cheaper metals." Estimates in each test city were made using identical sets of actual residential plans in order to make a test under actual field conditions. And look what happened! In four test cities, from East to West, *a complete copper installation cost less than other metals!* In materials, the cost of copper tube installation was an eye-opener according to field reports... far less in most cases than the estimator expected!

Point out these facts to your contractor customers—for more sales and profits!

Chase®
BRASS & COPPER CO.
WATERBURY 20, CONN.
Subsidiary of
Kennecott Copper Corporation

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York (Maspeth, L.I.) Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

THE MARK OF QUALITY

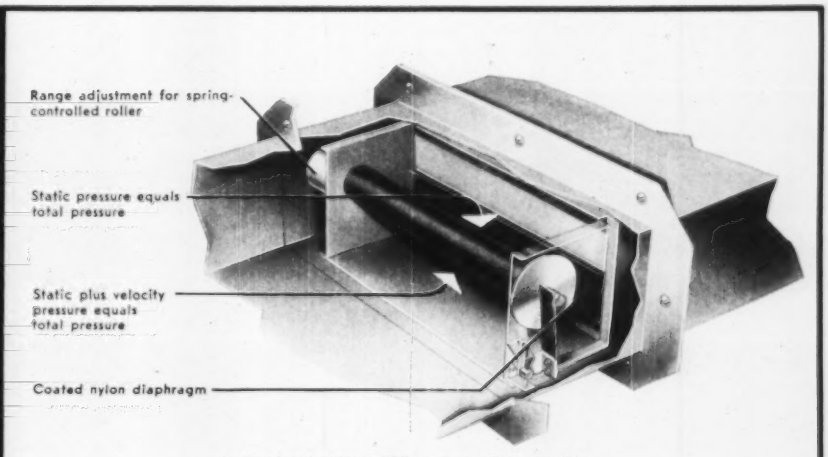
BARBER COLMAN

Uni-Flo

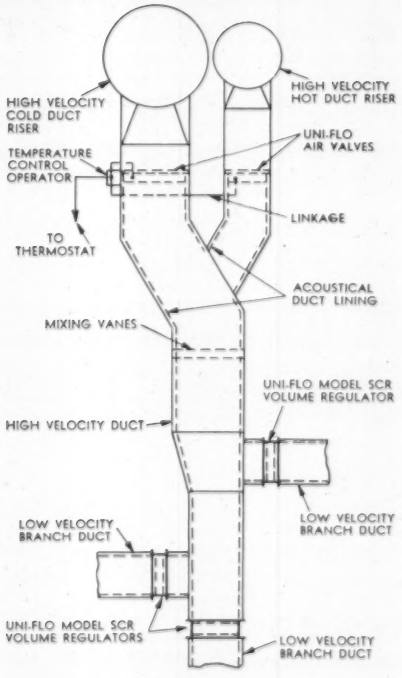
ENGINEERED AIR DISTRIBUTION

New for high velocity systems! Self-operated Constant Volume Regulator

- Maintain cfm delivery within ± 5% for inlet air pressure differences as high as 5:1.
- Completely self-contained — requires no power source other than the air flow.
- Fully adjustable before or after installation.


Range adjustment for spring-controlled roller
Static pressure equals total pressure
Static plus velocity pressure equals total pressure
Coated nylon diaphragm

Barber-Colman Model SCR constant volume regulator



Schematic diagram of SCR constant volume regulators installed in high velocity duct system

The new Uni-Flo Model SCR constant volume regulator is applicable anywhere in a duct system where there are changes in static pressure. No motor operator or other power source is required. Only requirement for its operation is a minimum of 0.75 inches of static pressure.

As illustrated above, both static and velocity pressure exist under the flexible diaphragm where the air can pass through the baffle plate. Static pressure only exists above the diaphragm where the air is trapped.

A static pressure increase above the diaphragm forces it downward, limiting the open area of the baffle plate. Conversely, when static pressure decreases, the diaphragm raises, exposing a larger opening area. Thus, a constant cfm delivery is maintained regardless of pressure changes in the system.

Here is your simple, positive, economical answer to extremely accurate constant volume control. The Model SCR is also available in a double-duct control unit for direct connection to the hot and cold ducts. For complete details and literature, call your Barber-Colman representative or write today.

BARBER-COLMAN COMPANY

Dept. K, 1101 Rock Street, Rockford, Illinois

Air Distribution Products • Automatic Controls • Small Motors • Industrial Instruments • Aircraft Controls • Electrical Components • Overdoors and Operators Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

THE MARK OF QUALITY

BARBER COLMAN

Wheelco Instruments

Manual or automatic

Wheelco Flame-otrols

for flame-failure protection

Features of the Wheelco super-duty automatic Flame-otrols are visible at a glance in this special display installation. Note ready accessibility of principal components.

Automatic Operation

Sequence timing for oil- or gas-fired burner or boiler application includes: purging, warm-up proving, pilot proving, low-fire stabilization, ignition timing, and post purging. Terminal connections for directly handling a flame-failure alarm and a proportioning-type control motor are also included. Model 1474 uses flame-rods and emissive-type photo cells as sensing elements, while Model 1574 uses lead-sulphide cells as sensing units.

Manual Starting

Once the oil- or gas-fired furnace, oven, etc. is started, the Flame-otrol shown here takes over the problem of flame supervision. After fuel ignition, the manual model provides for complete burner shutdown protection immediately following flame outage or high-limit "off" switching. Flexible circuit design makes possible use of various auxiliary equipment such as push-button starting, external timers for purging or timed ignition trial. Both "CR" systems using flame-rods and "IR" systems using lead-sulphide sensing cells are available.

Addition of super-duty automatic models for package boiler installations rounds out complete line of combustion safeguards for gas, oil, or combination burners.

Whatever the combustion safeguard requirements on furnaces, boilers, kilns, dryers, and similar applications — there's a Wheelco Flame-otrol to provide superior performance and unmatched dependability. The same sure operation and simplified maintenance that has characterized the manually or semi-automatically started models is designed into the new super-duty Flame-otrols for package boiler operations.

TWO BASIC SYSTEMS

Basically, there are two control systems available for Flame-otrol operations: Conductivity-Rectification "CR" system and Infra-Red "IR" system. A lead-sulphide cell is used as a sensing element in the "IR" system; flame-rods and emissive-type photo cells are sensing elements in the "CR" system.

Both flame "pick-up" methods are available in automatic or manually started models. Compact, plug-in design is incorporated in all models, offers maximum accessibility for adjustment, examination, and repair. The chassis are held in position for normal operation by captive latches or a retaining screw with the exclusive Wheelco terminal strip guaranteeing uniform contact pressure while permitting easy removal.

SIMPLIFIED MAINTENANCE

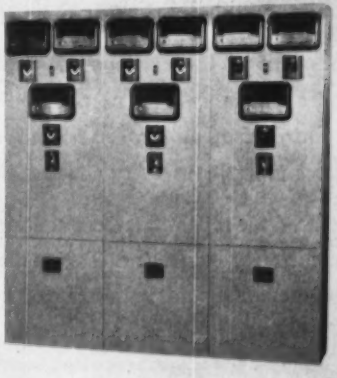
Convenient checking strips simplify trouble-shooting and normal maintenance — require only the use of standard instruments for checking circuits and voltages. Because standard electronic tubes are used throughout, inventory requirements of spare parts are reduced appreciably. Replacements can be obtained readily at any electronic supply house.

Heavy-duty construction of Wheelco Flame-otrol cabinets is an important factor in long, trouble-free operation of the units in all types of plant locations. The rugged, industrial-type steel cabinet with gasketed, dust-tight swing-out cover keeps out foreign matter that might interfere with operating efficiency. Applications requiring a flush-mounted unit are furnished with a cabinet that includes the necessary mounting flange.

Write for literature describing operations of either manual or automatic Flame-otrols today or, better still, have a Wheelco field engineer analyze your combustion safeguard needs. There's no obligation and you can be sure this analysis will be thorough with the recommendations specifically directed to the solution of your problems.

Control Centers

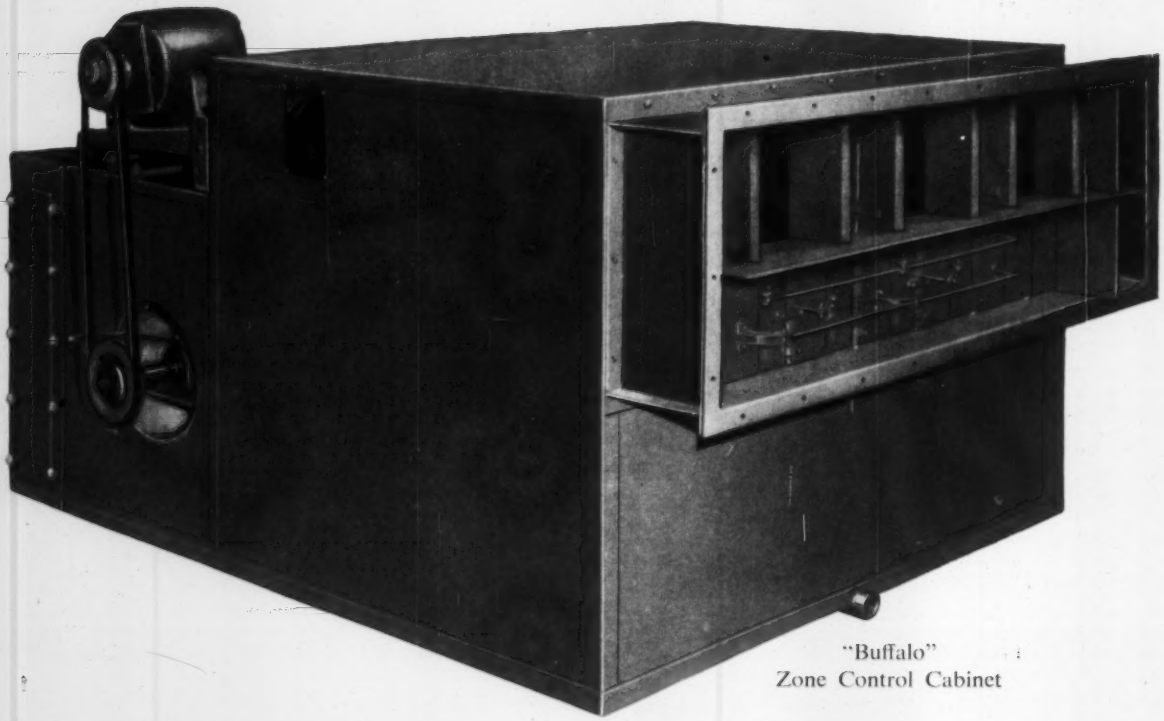
Where a method of housing a complete combustion safeguard system, including Flame-otrols, pilot lights, alarms, etc., is required or desirable, prewired Wheelco control centers reduce installation costs and time, plus providing an attractive centralized package. Flexibility to meet changing requirements is provided by use of removable sections. Bolt-down or hinged covers permit convenient servicing or system checking.



BARBER-COLMAN COMPANY

Dept J, 1501 Rock Street, Rockford, Illinois, U. S. A.

BARBER-COLMAN of CANADA, Ltd., Dept. S, Toronto and Montreal, Canada



"Buffalo"
Zone Control Cabinet

INDIVIDUAL ZONE CLIMATE CONTROL WITH THIS *ONE* VERSATILE CENTRAL CONDITIONING UNIT

This quiet operating unit provides each of many zones with the exact combination of air conditioning required, from a single, central source. Temperature is controlled by mixing cooled and heated air in the correct proportions to suit each conditioned space.

The need for separate re-heat coils and their controls is completely eliminated. Sectionalized design facilitates handling and installation. The entire unit is ruggedly constructed for a long life of maintenance-free operation.

Investigate the many advantages of "Buffalo" Zone Control Cabinets. Phone your "Buffalo" engineering representative, or write for Bulletin AC-220.

"Buffalo" products bring you the extra "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

"Buffalo"

BUFFALO FORGE

Buffalo Pumps Division, Buffalo, N. Y.

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT

ENGINEERING FEATURES OF "BUFFALO" ZONE CONTROL CABINETS:

FAN SECTION — Fans are all aluminum for weight-saving, corrosion and spark resistance. Mixed flow wheels provide fully stable, highly efficient operation. Steep pressure characteristic minimizes variation in capacity and power. Streamlined housings are designed for low air velocities. Oversize hollow shafts are perfectly balanced and allow ample safety margin. Bearings are self-aligning, grease lubricated, ball type — externally mounted for convenient maintenance.

COIL SECTION — Unique design with coils mounted at an angle permits maximum coil face area with minimum headroom and length. One piece pan is all-welded heavy gauge sheet, with rigid structural frame covered on inside with corrosion-resistant insulating compound.

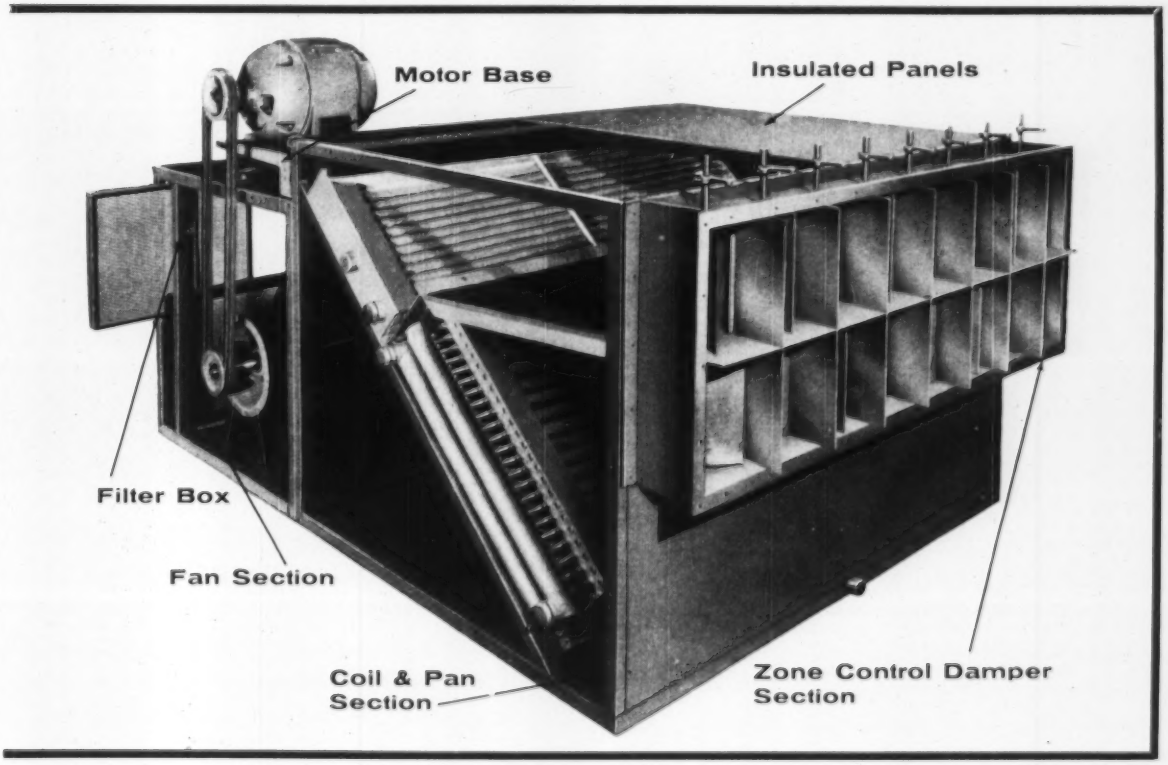
ZONE DAMPERS — Easily-removable, heavy gauge, all-welded frame and divider sheets. Blades are die-formed for stiffness and tight fit. Each zone has blade stops and extended shaft for damper control. Optional horizontal or vertical up-discharge permits minimum space without need for expensive discharge elbow.

FILTER BOX — Space-saving filter box is built into the fan section. Filters are easily replaceable.

MOTOR BASE — Completely adjustable for proper belt tension and different motor frame sizes.

INSULATED PANELS — Heavy sheet steel panels are insulated with ½" fiber glass.

ACCESSORIES — Filter boxes — either parallel type for low velocity cells, or flat type for high velocity cells. Mixing box either standard or combination style. Face dampers, or face and by-pass type. Humidifiers are steam grid or spray type. Resistance plate is either fixed or variable.



COMPANY, **BUFFALO, NEW YORK**

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

It's the Showcase of the Industry!

SEE THE NEWEST IN PRODUCTS LIKE THESE AT THE EXPOSITION

Air-conditioning units and systems, boilers, burners, fans, blowers, bearings, condensers, compressors, controls, coolers, fittings, filters, engines, exhausters, heat exchangers, eliminators, dehumidifiers, diffusers, couplings, pipe cutters, drills, pumps, preheaters, motors, meters, piping, valves, hose, furnaces, heaters, grilles, hangers, gages, flanges, ventilators, washers, water treatment, tubing, traps, cooling towers, thermostats, thermometers, tanks, switches, finned surfaces, separators, regulators, refrigerants, radiators, recorders, coils, baseboard radiation, humidifiers, transformers, ducts, insulation, evaporators, registers, after coolers, circulators, controllers, cooling equipment, dampers, strainers, connection heaters, etc.

the 14th International Heating & Air-Conditioning Exposition

Under the auspices of the
American Society of Heating & Air-Conditioning Engineers
and in conjunction with their Annual Meeting.

Convention Hall
Philadelphia
January 26-29, 1959

Here under one roof you'll see and compare the newest products . . . talk to the informed representatives of 450 leading manufacturers . . . spot future trends . . . and be better prepared to meet tomorrow's problems.

This is a concentrated course in the latest developments arranged *for* men in the business *by* men in the business. You'll hear and see fresh ideas, channeled especially to you and your business. You'll find the Show an important place to gain new insight into both your job and your industry.

14TH INTERNATIONAL HEATING & AIR-CONDITIONING EXPOSITION
480 Lexington Avenue, New York 17, N. Y.
MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY

Make your plans to attend, now!

Fill in and mail the coupon for advance registration and hotel information.

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Name_____ Title_____
Company_____
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Products Made Or
Type of Business_____

☐ Check here if application form for hotel reservation is required.

1260

How to cut costs with the RIGHT motor

Don't be baffled by power factors, torques, efficiencies, and starting, accelerating, and thermal characteristics, or housing, horsepower and speed control. Let Century Electric help you balance these factors to cut operating costs with the *right* motor.

Here's how Century Electric can help you:

10,000 choices—Century Electric engineers can help you specify the right motor without having to rely on a few types to do all jobs. Century Electric makes a complete variety of integral horsepower motors. Over 10,000 types up to 400 hp. There is one for every type of equipment—transfer machines, ball mill drives, compressors, drilling machines, lathes, etc. For all operating conditions too—dusty, corrosive, explosive or moist.

Long life motors—And you get years of dependable operation from Century Electric motors. They are manufactured to rigid quality standards. Electrical tests and other checks on operating characteristics made during manufacture assure you the best motor for your money.

Application know-how—Every Century Electric sales engineer knows motor drive systems because he sells motors and nothing but motors. Often he can give you on-the-spot answers. If not, he can turn to an engineering staff that comes up with quick answers.

You can get the right motor for your equipment just by contacting your nearest Century Electric Sales Office or Authorized Distributor. A Century Electric sales engineer will be glad to help you.

CENTURY ELECTRIC COMPANY

St. Louis 3, Missouri *Offices and Stock Points in Principal Cities*

Century

58-22

For the world's most complete

make mine

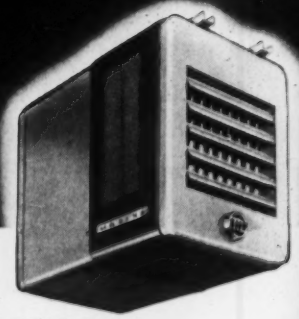
Since the early 1920's when Arthur B. Modine introduced the first lightweight, suspended, propeller-type unit heater, Modine has been a leader in the development of unit heaters and their application to industrial and commercial heating.

Today's Modine unit heating equipment line is the world's broadest . . . with types, models and sizes to match any temperature, air delivery and location requirement.

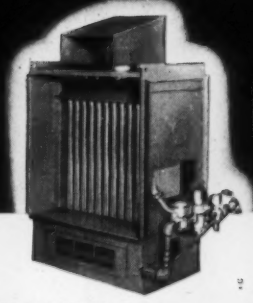
Full details on Modine steam and hot water unit heaters are contained in Catalog 158. Gas-fired products are described in Catalog 658. See your local Modine stocking distributor or write Modine Mfg. Co., 1509 DeKoven Ave., Racine, Wisconsin.

Gas fired

PROPELLER UNITS.
Beautifully styled, fuel-thrifty, lightweight. Stainless steel burners. Eight models — 25,000 to 310,000 Btu.

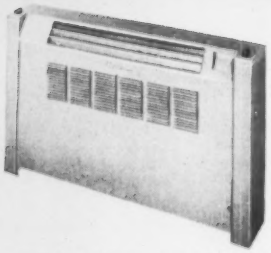


BLOWER UNITS.
For heating, ventilating. May be installed in area served or remotely located with duct work. Seven models — 50,000 to 310,000 Btu.

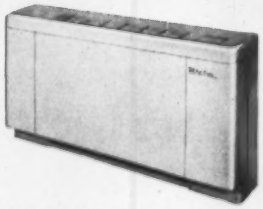


DUCT FURNACES.
Stainless steel heat exchangers and burners. Ideal for air conditioning systems or straight heating. Five models — 88,000 to 213,000 Btu.

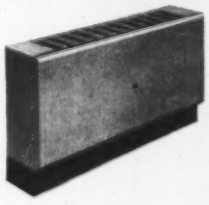
Here are other popular Modine



SELF-CONTAINED AIRditioners.
Incorporate 2-pipe steam or hot water heating with a self-contained refrigeration circuit.



CHILLED-WATER AIRditioners.
Cool with chilled water, heat with hot — from a central source. Four sizes, ⅔ to 2 tons.



CABINET UNITS.
Provide quiet, positive heating, ventilating. Seven enclosure types — 120 to 640 Edr.

unit heater line, just say...

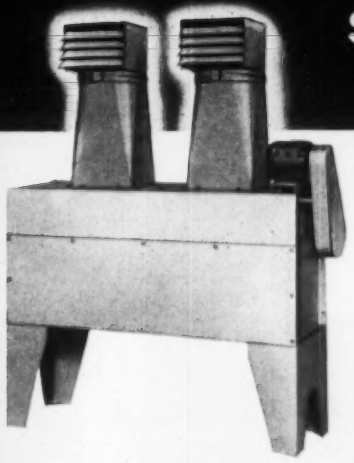
MODINE

HORIZONTAL DELIVERY TYPE.
Versatile in application, easy to install. Can be directly suspended from supply line without other supports — 24 standard and low-outlet-temperature models.

VERTICAL DELIVERY TYPE.
Offered in 28 standard and low-outlet-temperature models. Choice of four air deflectors. Lightweight, rugged construction.

"POWER-THROW" TYPE.
For hard-to-heat locations. Powerful horizontal discharge "throws" heat up to 140 ft. 10 standard and low-outlet-temperature models.

Steam and Hot Water

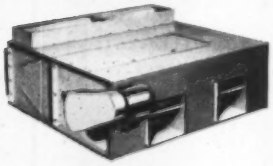


BLOWER UNITS.
Designed for large-volume air handling applications. Available in 5 types, each in 8 sizes ranging from 600 cfm to 33,000 cfm.

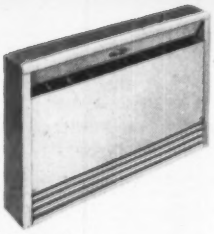
HCR

HIGH CORROSION RESISTANT MODELS.
For use where severe internal corrosion is a problem. Available in all three propeller types, in 44 models, these units carry triple the standard guarantee.

products



HEATING AND VENTILATING UNITS.
Offered in 5 types, 8 models, in sizes from 600 to 33,000 cfm. Wide range of accessories to accommodate any application.



CONVECTORS.
Offered in 30 types and 8,000 sizes for every building need. Choice of standard and heavy-gauge enclosures.

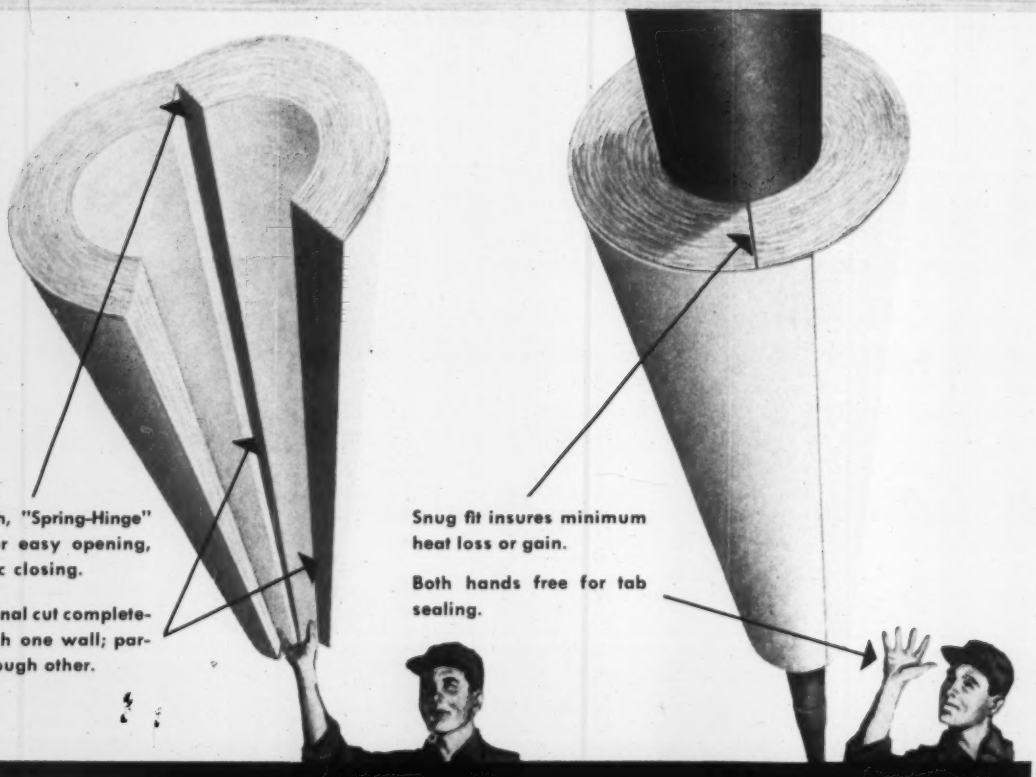
Modine
MANUFACTURING COMPANY

In Canada: Sarco Canada, Ltd., Toronto 8, Ontario

UR-1379

MICRO · LoK

PIPE INSULATION*



Full-length, "Spring-Hinge" action for easy opening, automatic closing.

Longitudinal cut completely through one wall; partially through other.

Snug fit insures minimum heat loss or gain.

Both hands free for tab sealing.

HERE'S A "BIRD'S-EYE" VIEW OF MICRO·LoK:

"Spring-Hinge" Action

One-piece construction and automatic closing feature introduces new savings in application costs; increases efficiency of workers by quickly freeing hands for sealing tabs and other operations.

Light in Weight

Three foot section of 1" thick MICRO•LoK for fitting 2" pipe weighs ¼ lb. L.F.— only ⅛th the weight of insulations which require more thickness to do the same job.

Excellent Thermal Performance

Made of finer, longer fibers, it has efficiency equal to or better than commonly used insulations. Temperature limit is 350° F. — unaffected by sub-freezing temperatures.

*PATENTS APPLIED FOR

©1958 L·O·F Glass Fibers Company

Look to L·O·F Glass Fibers for the NEW things in fiber glass

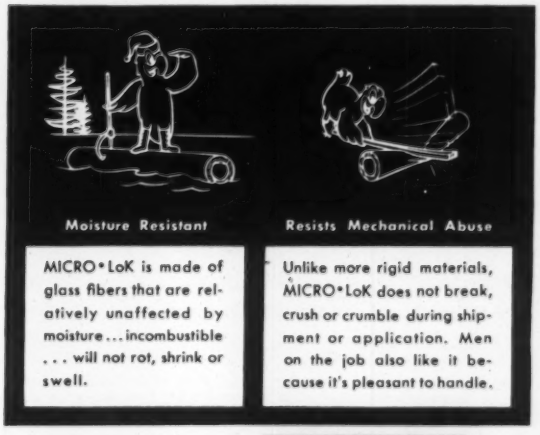
Another first from L·O·F Glass Fibers Company

for better performance and faster application

featuring full-length, "Spring-Hinge" action

1. The *first* one-piece, full-length "Spring-Hinge" action for easy opening and automatic closing.
2. The *first* fiber glass pipe insulation that permits easy cutting and fitting of the inside diameter around couplings, unions, pipe hangers and other irregularities.

The L·O·F Glass Fibers' process permits production of all standard wall thicknesses —especially ½" and ¾" walls—for all pipe and copper tubing sizes.


Moisture Resistant
MICRO•LoK is made of glass fibers that are relatively unaffected by moisture... incombustible ... will not rot, shrink or swell.
Resists Mechanical Abuse
Unlike more rigid materials, MICRO•LoK does not break, crush or crumble during shipment or application. Men on the job also like it because it's pleasant to handle.

SUPERIOR THERMAL EFFICIENCY

LESS WALL THICKNESS REQUIRED

TEMPERATURE LIMIT OF 350° F.

UNAFFECTED BY SUB-FREEZING TEMP.

FASTER APPLICATION AT LOWER COST

MICRO·LoK Pipe Insulation is available in factory applied jackets—including canvas, vapor barriers, flame resistant—for all operating conditions, whether hot or cold, concealed or exposed, indoor or outdoor.

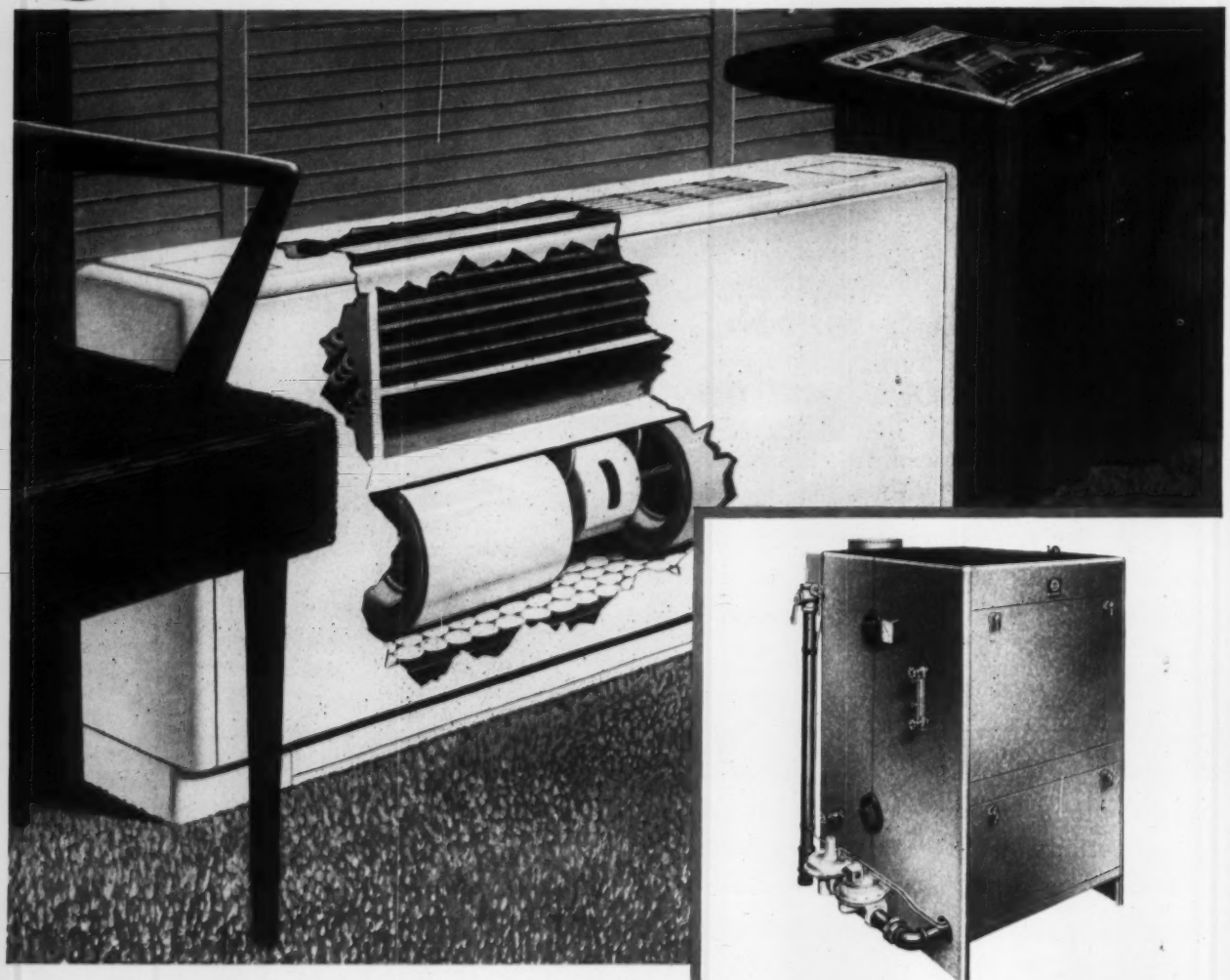
For more information on sizes, recommended thicknesses and application, call or write the nearest L·O·F Glass Fibers Company sales Office.

L·O·F GLASS FIBERS

L·O·F GLASS FIBERS COMPANY

TOLEDO 1, OHIO

American-Standard air

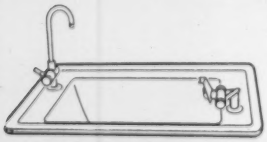


New 9-inch thin room units in three practical models and four sizes. All are 9″ thin and 25″ low. Capacities are test-rated and laboratory-proven. Remotaire units feature exceptional quietness through slow-speed motors (1050 rpm maximum), large coil surface and filter area, heavy insulation and no reactors or auto-transformers.

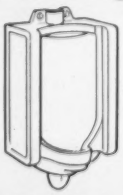
New G-6 Gas Boiler only 65″ high for minimum headroom. Equipped with cast iron base for fast, low-cost installation. Constructed of lifetime cast iron. Ratings approved by I=B=R and boiler approved by A.G.A. Inputs of 650,000 to 5,200,000 Btu per hour. May be installed singly or in battery in large buildings for hot water or steam operation.

American-Standard and "Standard" are trademarks of American Radiator & Standard Sanitary Corporation

There's a plumbing fixture for every building...

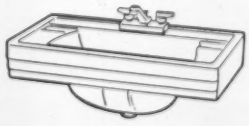


New Ledgeworth cast iron drinking fountain



Casal urinal

Glenco wall-hung toilet



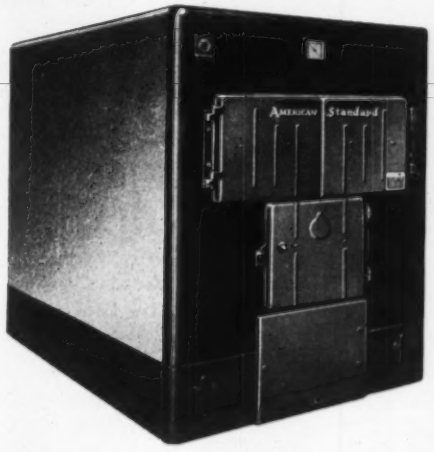
New Buena lavatory

conditioning...test-rated, dependable, flexible

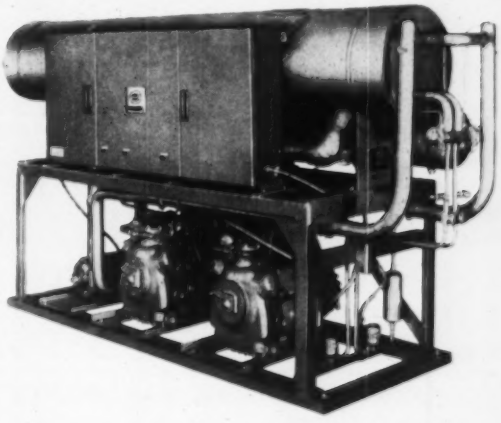
When you specify American-Standard Remotaire air conditioning, you can rely on it for *test-rated capacities, dependable performance, quiet operation, compact styling, sturdy construction, flexible installation, reasonable initial and operating costs.* This modern hydronic* system of hot water heating and chilled water cooling features individual room temperature control and maximum comfort in minimum space. Compact equipment is easy to handle—requires shortest possible installation time.

For more information call your local representative, or write: AMERICAN-STANDARD, PLUMBING AND HEATING DIVISION, 40 W. 40th Street, New York 18, New York.

**Hydronics, the science of heating and cooling with water.*



New A-7 cast iron oil boiler features exclusive new optional steel pedestal that eliminates need for pit or firebrick base. Cast iron sections are factory-tested at 2½ times normal operating pressure with tappings for external domestic water heater. Boiler is designed for oil or stoker firing with gross I=B=R outputs of 866,000 to 2,148,000 Btu per hour.

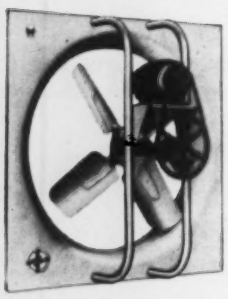


Packaged Water Chiller is completely factory-assembled, with all circuits piped, wired and tested. Your installation time is cut to minimum, because no field assembly work is needed. Compact, easy-to-handle units are provided with wood skids for fast, safe shipment. Available in complete range of sizes, from 7½ hp to 125 hp; may easily be installed in batteries.

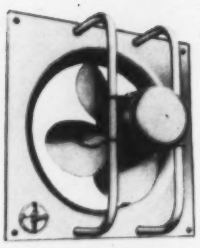
AMERICAN-Standard PRODUCTS

AMERICAN-Standard

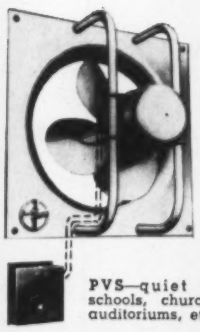
PLUMBING AND HEATING DIVISION



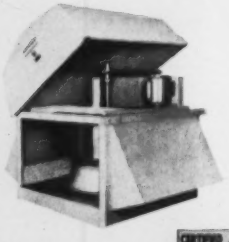
PVB—generally used in factories, warehouses and foundries.



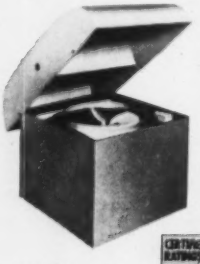
HS—for industrial use, farm buildings, laundries, etc.



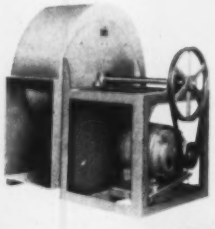
PVS—quiet for schools, churches, auditoriums, etc.



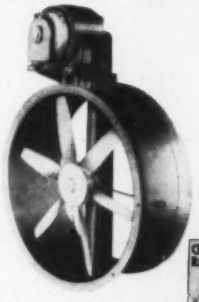
CENTRIFUGAL POWER ROOF VENTILATOR—for auditoriums, schools, churches, public buildings, plants.



PROPELLER-TYPE ROOF VENTILATOR—for apartments, plants, schools, etc.



BACKWARD CURVE BELT DRIVE UTILITY BLOWER—recommended for general ventilation.



DUCT or TUBAXIAL—for paint spray booths, etc. —explosion-proof.

Peerless-Electric®

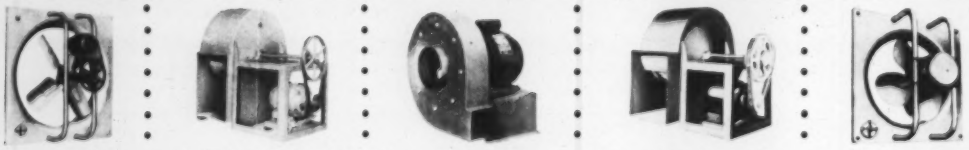
AIR MOVING EQUIPMENT

is designed for low initial cost and continuous, trouble-free performance.

Peerless Electric air moving equipment offers the user low initial cost and trouble-free, continuous performance. Each unit is completely Peerless built. Motors are designed, engineered and manufactured in the Peerless Electric Motor Division. They are made to N. E. M. A. specifications and performance-matched to the fans or blowers they must power.

Each Peerless Electric unit indicated with the AMCA seal is rated by the new Air Moving and Conditioning Association. Installation data, performance tables, dimensions, ratings, general construction data, recommended specifications, and guarantee information are all available in the new Peerless Electric catalogs. Write for a complete set today.

A COMPLETE LINE OF AIR MOVING EQUIPMENT



Member of the Air Moving and Conditioning Association, Inc. (AMCA)

Peerless-Electric®

FAN AND BLOWER DIVISION

THE Peerless-Electric® COMPANY

1409 W. MARKET ST. • WARREN, OHIO

FANS • BLOWERS • ELECTRICAL MOTORS

Locate Your Nearest Representative in the "Yellow Pages"

SEE OUR CATALOG IN SWEET'S

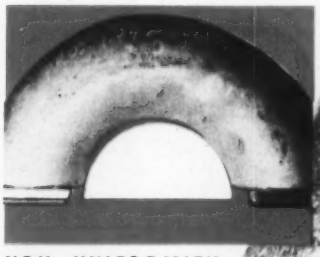
Watch out for the risks of

QUESTION MARK FITTINGS!

- *WASTED DOLLARS*
- *PRODUCTION SHUTDOWNS*
- *HAZARDS TO LIFE*
- *DAMAGE TO YOUR REPUTATION*

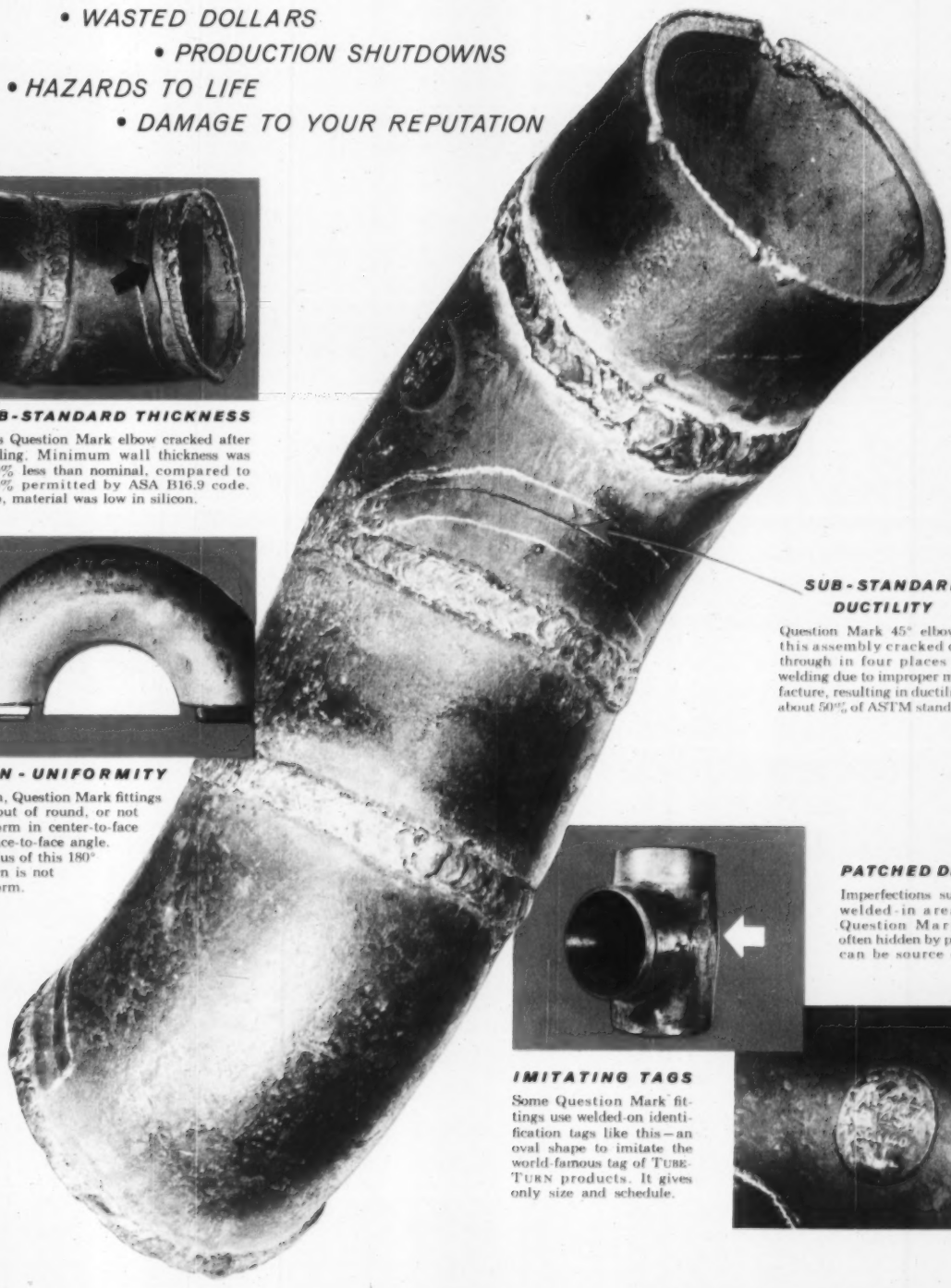
SUB-STANDARD THICKNESS

This Question Mark elbow cracked after welding. Minimum wall thickness was 24.9% less than nominal, compared to 12.5% permitted by ASA B16.9 code. Also, material was low in silicon.



NON-UNIFORMITY

Often, Question Mark fittings are out of round, or not uniform in center-to-face or face-to-face angle. Radius of this 180° return is not uniform.

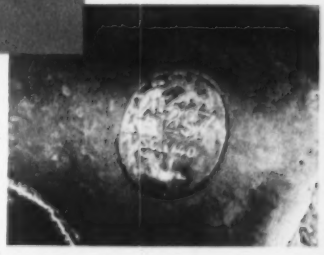


SUB-STANDARD DUCTILITY

Question Mark 45° elbows of this assembly cracked clear through in four places after welding due to improper manufacture, resulting in ductility of about 50% of ASTM standards.

PATCHED DEFECTS

Imperfections such as the welded-in area of this Question Mark tee are often hidden by paint. They can be source of failure.



IMITATING TAGS

Some Question Mark fittings use welded-on identification tags like this—an oval shape to imitate the world-famous tag of TUBE-TURN products. It gives only size and schedule.

A message in the interests of top-quality piping . . . by
Tube Turns, Louisville, Kentucky

TO AVOID THESE RISKS . . .

TUBE-TURN *Welding Fittings are completely identified. Information given: Manufacturer's identification, size and wall thickness, material or type number, schedule number or weight, laboratory control number.*

specify and buy top-quality

TUBE-TURN® PRODUCTS

AVAILABLE NEARBY. Your Tube Turns' Distributor gives you prompt delivery from a complete line of more than 12,000 stocked items of TUBE-TURN products. Photo courtesy Central Rubber & Supply Co., Inc., Indianapolis.

"Cheap" Question Mark fittings can be mighty costly in the long run. It pays to safeguard your piping investment, *and your reputation*, by insisting on *known* fittings.

When you specify and buy TUBE-TURN* Fittings and Flanges, you know you are getting unsurpassed quality. They meet all American Standard and Safety Code requirements and are fully and permanently identified for your protection.

The trademarks "TUBE-TURN" and "tt" are applicable only to the quality products of Tube Turns.

*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

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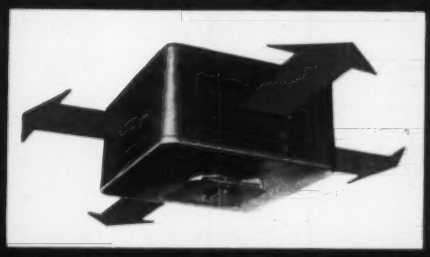
DIVISION OF CHEMETRON CORPORATION

Louisville 1, Kentucky

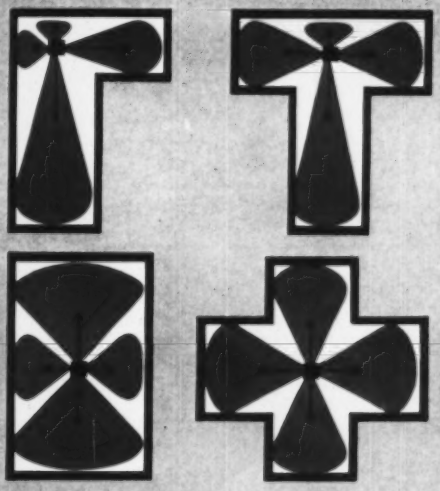
DISTRICT OFFICES: Atlanta • Chicago • Dallas • Denver • Detroit • Houston
Kansas City • Los Angeles • Midland • New Orleans • New York • Philadelphia
Pittsburgh • San Francisco • Seattle • Tulsa

IN CANADA: Tube Turns of Canada Limited, Ridgetown, Ontario
DISTRICT OFFICES: Edmonton • Montreal • Toronto • Vancouver

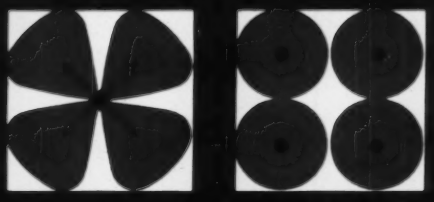
CHEMETRON



Carrier "Clover Leaf" Unit Heaters, for steam or hot water, come in eight sizes, ranging from 55,000 to 600,000 Btu/hr.



Adjustable louvers can shape "Clover Leaf's" air distribution pattern to heat any shape area.



One large "Clover Leaf" can heat this 100-foot-square room. It takes four vertical discharge heaters with same capacity to do this same job.

1 Carrier Unit Heater replaces 2 or more ordinary unit heaters

save your client's money when you modernize heating systems or specify new heaters for plant additions

Whether your client is building a new plant or modernizing an existing one, you can save him money on his heating system by specifying Carrier's "Clover Leaf" Unit Heater. One of these versatile heaters does the job of two or more vertical discharge heaters —or four to six horizontal heaters.

The reason for this unusual performance lies in the "Clover Leaf's" unique method of air distribution. It gives greater heating coverage by discharging heated air in as many as four directions at one time. Using all four of its outlets, the largest of these Carrier units can heat a room 104 feet square. Or blowing air in two directions it can heat a narrow building 136 feet long!

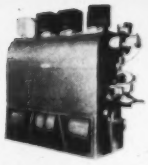
Adjustable louvers make it easy to vary the shape of the "Clover Leaf's" air distribution pattern. Without changing outlets or adding accessories it can heat L, T, I or square shaped buildings.

Because of its greater heating coverage you need fewer "Clover Leaf" heaters to do a heating job. That means more than just lower first cost. It also means a lower installation cost, lower operating and maintenance cost—lower costs right down the line.

For complete information about the "Clover Leaf" Unit Heater call your Carrier representative listed in your Classified Telephone Directory under "Heaters—Unit." Or write Carrier Corporation, Unit Heater Department, Syracuse, N. Y.

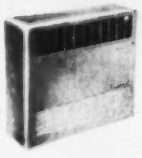
Carrier

industrial heating • air conditioning • refrigeration



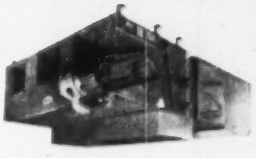
Direct Fired Heat Diffusers

Horizontal Unit Heaters



Cabinet Unit Heaters

Gas-fired Unit Heaters



Heating and Ventilating Units

UNION
CARBIDE
Ucon
BRAND
refrigerants

Coming soon...

Ucon

BRAND

refrigerants

Important News For the Refrigeration and Air Conditioning Industries...

UCON Refrigerants will be dry, pure, top quality

With UCON Refrigerants you will get quality that meets the highest industry standards. And you can choose from five grades, UCON 11-12-22-113-114.

But you'll get more. Much more.

Personal Service from technically trained representatives. The UCON Refrigerants service force is the largest in the United States.

Full Choice of Unit Sizes to meet your needs. UCON Refrigerants will be available in 10, 25, 145 lb., or ton cylinders; truck-tank or tank-car quantities.

Prompt Delivery from the largest network of distribution points serving America's refrigeration and air conditioning industries.

America's newest fluorocarbon plant will bring you a UCON Refrigerant for your air conditioning and refrigeration application. And there are new, exciting developments, soon to come. For full data write UCON Refrigerants, Union Carbide Chemicals Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, New York.

"Ucon" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

UNION CARBIDE

Ucon

BRAND

refrigerants

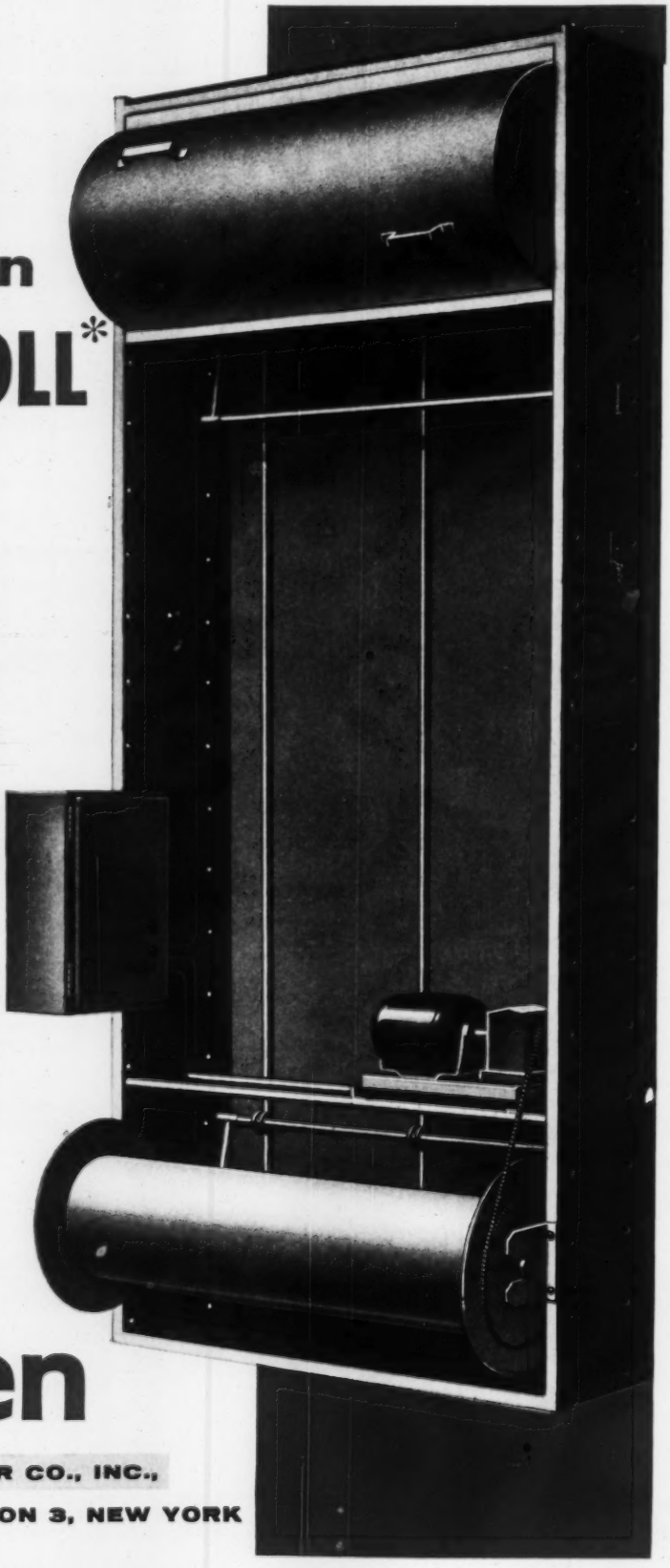
These 5 UCON Brand Refrigerants will meet your refrigeration and air conditioning needs

UCON Refrigerant 11 Trichloromonofluoromethane
UCON Refrigerant 12 Dichlorodifluoromethane
UCON Refrigerant 22 Monochlorodifluoromethane
UCON Refrigerant 113 Trichlorotrifluoroethane
UCON Refrigerant 114 Dichlorotetrafluoroethane

UNION CARBIDE CHEMICALS COMPANY *Division of Union Carbide Corporation*

it's all working filter area with a Green ECON-O-ROLL*

AUTOMATIC AIR FILTER



With Green's unique design, each and every square inch of exposed media surface in ECON-O-ROLL works for you. None of the exposed media surface is ineffective.

ECON-O-ROLL also eliminates the problem of contaminated air leakage around the edges of the media, even while indexing, because of its exclusive free floating, self-adjusting seal assembly.

The automatic electrical control systems which are standard equipment with the ECON-O-ROLL, leave nothing to be desired. The control panels are completely wired, eliminating the need for costly job-site wiring. You have a choice of either a timer actuated system, or a system which is actuated by pressure differential. Both systems include a manual control push button, and an end-of-media switch with a warning light which signals the need of media replacement.

ECON-O-ROLL arrives on the job completely assembled and installation is accomplished with ease, because of its basic, simple design.

Why not investigate the merits of the ECON-O-ROLL filter? There is a size to fit your needs.

Simply write for Bulletin 176.

*U.S. Patents Pending

Green

THE GREEN FUEL ECONOMIZER CO., INC.,

BEACON 3, NEW YORK

Mr. Readi-Pakt, Right There at the Top!

Way up on top of the highest peak in the world, stands our hero, Mr. Readi-Pakt! Ask him how he got there, and he'll tell you there's only one way to climb a mountain—step-by-step. That's how Reading Tube reaches the quality-peak in copper and brass tube and pipe — through step-by-step supervision by specialists in a wholly integrated mill — from its own refinery to its own depots. It's the only way to get C.Q.C. (Complete Quality Control). It's the only way to produce a quality product second to none. Coupled with personalized service and efficient delivery it explains why Reading Tube continues to stand right there at the top!

IN TUBING — *Nothing Beats Copper* —
IN COPPER — *Nothing Beats READING!*

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CHICAGO, ILL.
305 W. 31st St.

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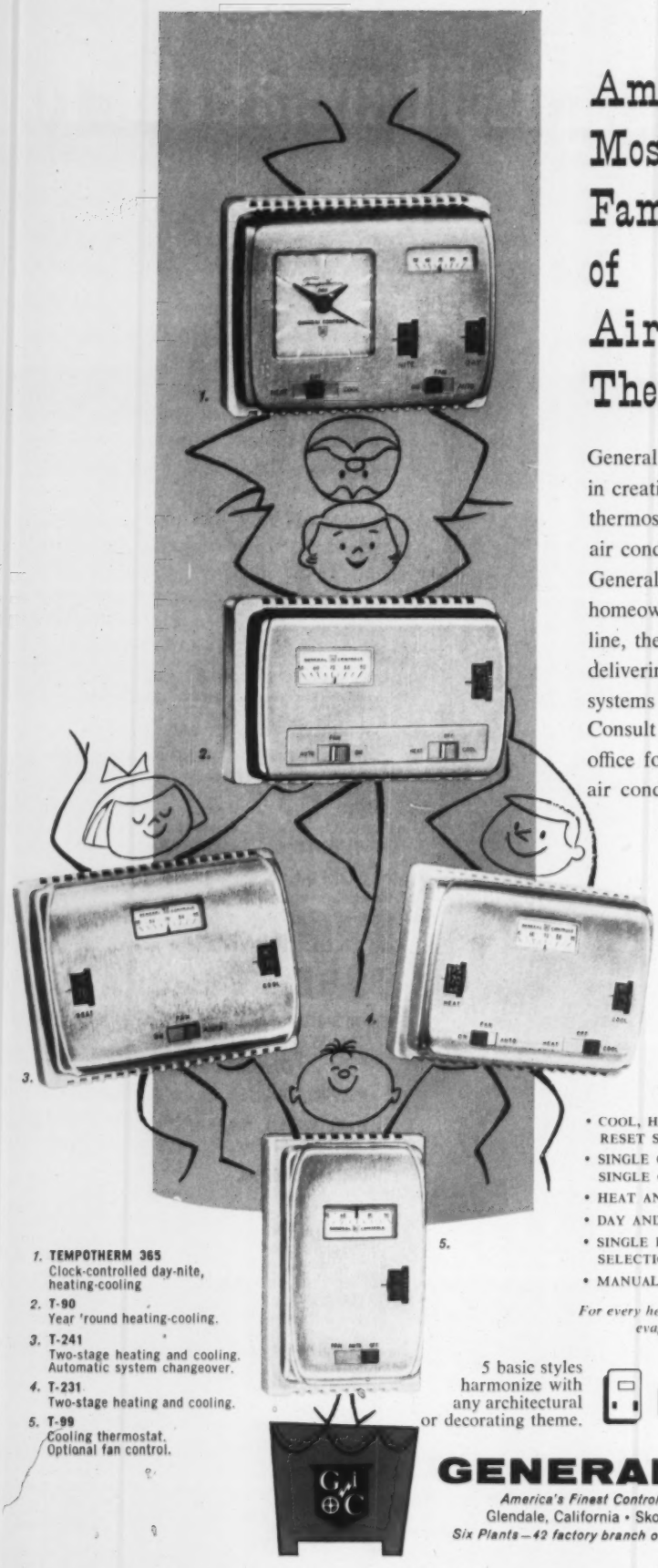
Industrial District

Sold Through Wholesalers Only

READING COPPER BRASS TUBE
And RED BRASS PIPE

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY



America's Most Complete Family of Air Conditioning Thermostats!

General Controls continues to set the pace in creating the kind of *advanced design* thermostats that afford maximum selectivity in air conditioning thermostats. Not only do General Controls thermostats please the homeowner with their beauty and simplicity of line, they also signify *quality*—and prove it by delivering the top performance engineered into systems and related equipment.
Consult your nearby General Controls branch office for complete details on the many air conditioning thermostats available.

ALL WITH MODERN MERCURY SWITCH DEPENDABILITY...

118 FUNCTION VARIATIONS TO CONTROL ANY SYSTEM

- COOL, HEAT, FAN, AUTO, OFF, RESET SWITCHING FUNCTIONS
- SINGLE OR TWO-STAGE HEATING WITH SINGLE OR TWO-STAGE COOLING
- HEAT AND COLD ANTICIPATION
- DAY AND NIGHT CLOCK PROGRAMMING
- SINGLE DIAL OR TWO DIAL TEMPERATURE SELECTION
- MANUAL OR AUTOMATIC CHANGEOVER

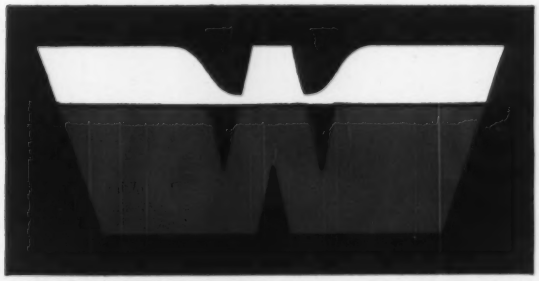
For every heating and cooling requirement: gas, oil, coal or electric; evaporative, chilled water and heat pump systems.

1. **TEMPOTHERM 365**
   Clock-controlled day-nite, heating-cooling
2. **T-90**
   Year 'round heating-cooling.
3. **T-241**
   Two-stage heating and cooling. Automatic system changeover.
4. **T-231**
   Two-stage heating and cooling.
5. **T-99**
   Cooling thermostat. Optional fan control.

5 basic styles harmonize with any architectural or decorating theme.

GENERAL CONTROLS

America's Finest Controls for Home, Industry, and the Military
Glendale, California • Skokie, Illinois • Guelph, Ontario, Canada
Six Plants—42 factory branch offices serving the United States and Canada

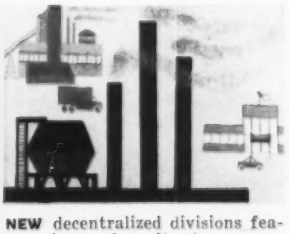


WORTHINGTON

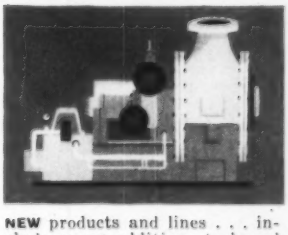
This is our new corporate face... a new symbol of our classic Worthington "wings." This new mark is much easier to see and attracts more attention. But it still represents the qualities and values which have made Worthington and Worthington products outstanding in performance, reliable in operation, trusted in every market place in the world.

This mark is by no means the only change at Worthington. There are many new air conditioning and refrigeration products and developments coming. You can expect brand-new improvements...brand-new, yet backed by the skills and experience of a leader in the air conditioning industry. These products will make news and they will be copied. We know that and expect it. It is part of the record of leadership that has been associated with Worthington for over 118 years. Worthington Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ontario.

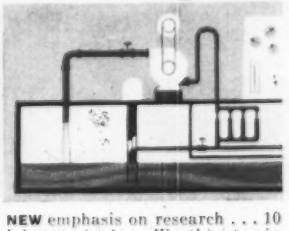
NEW sales organization...serves both direct and distributor sales, is geared to customer needs.



NEW decentralized divisions feature integral application, manufacturing and engineering units.



NEW products and lines . . . include many additions to broad lines of power service equipment.

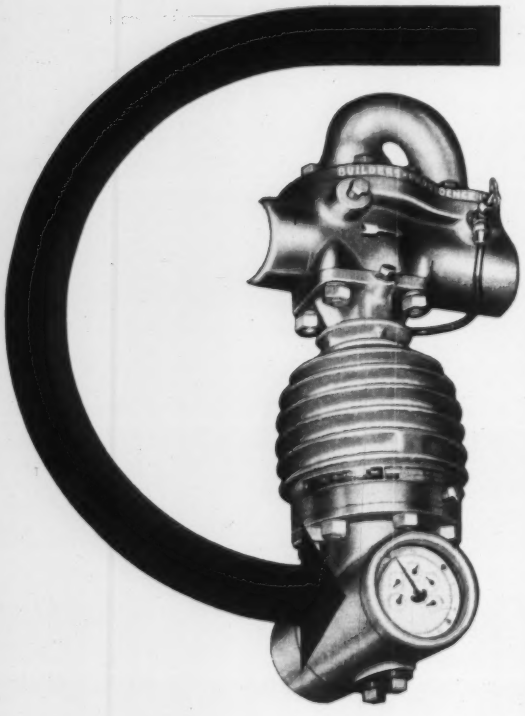


NEW emphasis on research . . . 10 laboratories keep Worthington in leading product-market position.

POSITIVE CONTROL OF MATERIALS IN MOTION B·I·F

Measure Steam in POUNDS, not GUESSES!

. . . with Builders-Providence PRESSURE-COMPENSATED Shuntflo® Meter!!



STEAM COSTS MONEY! Get an **exact accounting** of steam delivered to process, area, or building. The proven Shuntflo meter and its new PRESSURE-COMPENSATED COUNTER prevents unintentional steam give-away . . . particularly in installations subject to wide pressure fluctuations.

CHECK THESE ADVANTAGES . . .

- **Completely self-contained and self-operated**
- **High accuracy . . . to within ±2% of actual rate of flow**
- **Easy to install . . . in 1" to 24" lines**
- **Open upper limit . . . permits temporary overloads up to 150%**
- **Pressure compensation . . . continuous and automatic . . . corrects for line pressure variations**
- **No stuffing box . . . makes meter leakproof**
- **Low initial cost, low maintenance cost**

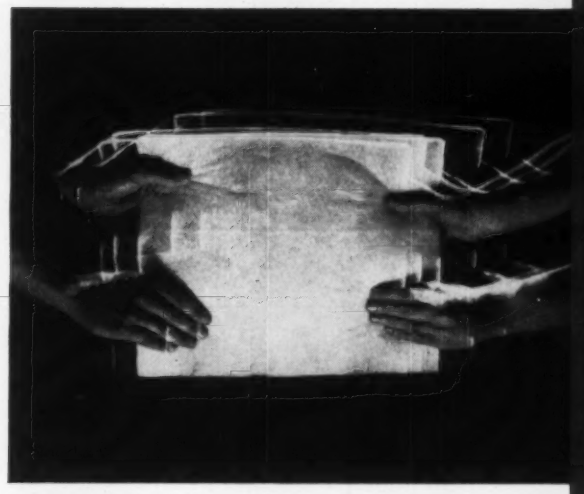
FREE BULLETIN shows how easy it is to change steam losses to profits. Request Bulletin 400.20 today! Write **B-I-F Industries, Inc., 381 Harris Ave., Providence 1, R. I.** . . . manufacturers of precision instruments and equipment for the *positive control of materials in motion.*

B·I·F

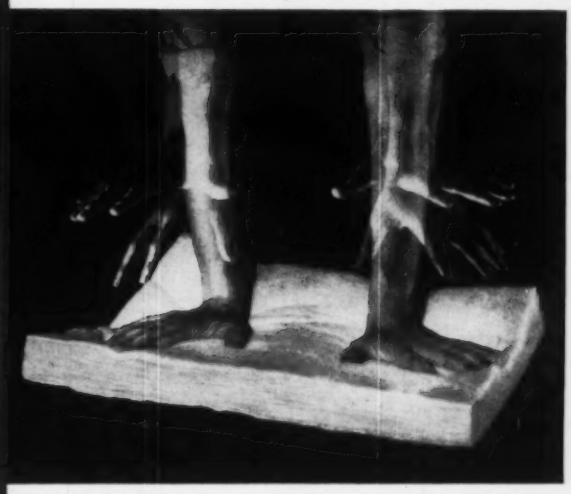
B-I-F INDUSTRIES

BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA

Try these 3 tests with Pittsburgh Superfine Fiber Glass Insulation



PULL IT—see how strong Pittsburgh Superfine is! It's built to last wherever you install it. It retains this same strength indefinitely. Won't disintegrate or rot with age.



PRESS IT—and see how it returns to its original shape. You can compress Pittsburgh Superfine for long periods of time, yet it will always spring back to its former shape!

GIVE IT A BEATING—and see how Pittsburgh Superfine absorbs the shock, and comes back. Pittsburgh Superfine loves rough handling.

PITTSBURGH SUPERFINE FIBER GLASS is great for insulating against heat or cold or noise. It's lightweight, cuts easily to correct size . . . is rot-proof, fire-resistant . . . handles easily, avoids skin irritation . . . saves installation time. Try it!

For complete information on Pittsburgh Superfine, call your nearest PPG Sales Office, or write to *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Penna.*

PITTSBURGH SUPERFINE INSULATION IS A PRODUCT OF THE FIBER GLASS DIVISION OF PITTSBURGH PLATE GLASS COMPANY

Sales Offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh and St Louis

75th ANNIVERSARY 1883–1958 PPG

SYMBOL OF SERVICE FOR SEVENTY-FIVE YEARS

PITTSBURGH PLATE GLASS COMPANY

SPECIFY • INSTALL

ALCO

T-SERIES

®THERMO EXPANSION VALVES

REFRIGERANT
FREON-12
FROM ½ TON TO 50 TONS
REFRIGERANT
FREON-22
FROM 1 TON TO 80 TONS
CARRENE-7
FROM ¾ TON TO 60 TONS
PROPANE
FROM 1 TON TO 88 TONS

Super charges for any application.
Available with external or internal superheat adjustment and external or internal equalizer.
Widest variety of body styles and connections.

to change capacity... or to clean

Simply . . . loosen screws lift out cage... you never break connections

2 body designs meet every requirement . . .
STRAIGHT-THROUGH CONNECTIONS or RIGHT ANGLE CONNECTIONS

Call your Alco wholesaler.
Write for Specifications Bulletin No. 171-56.

• *BUY SECURITY*
• *BUY QUALITY*
• *BUY ALCO*

ALCO VALVE CO.
5621 KINGSLAND AVE. • ST. LOUIS 5, MO.

7802

The one complete line of refrigerant controls: Thermostatic Expansion Valves · Refrigerant Distributors Solenoid Valves · Suction Line Regulators • Flooded Evaporator Controls and Reversing Valves

MULTI-VENT®

low velocity air diffusers specified for the West's largest office building

Multi-Vent will handle the air distribution in over 70% of Kaiser Center's office building, the largest west of the Mississippi, scheduled for completion late in 1959.

Multi-Vent is the ideal air diffuser for office space because it need never be moved, or even adjusted when partitions are relocated. Distributing air at low velocities by gentle pressure displacement, Multi-Vent provides truly sightless, soundless, imperceptible air conditioning comfort, unmatched by any other diffuser.

Multi-Vent panels, adjustable valves and flexible duct connections are concealed in metal pan ceilings because standard perforated pans (with acoustic pads removed) serve as diffuser plates. Panels (with diffuser plate) install flush in plaster and fiber ceilings.

KAISER CENTER, Oakland, California

Architect: Welton-Becket & Associates, San Francisco
Mechanical Engineer: Dudley, Deane & Associates, San Francisco
Mechanical Contractor: Scott Company, Oakland

Recent Multi-Vent Installations Coast to Coast

Banker's Trust, New York City
Baptist Tabernacle, Atlanta
Boeing Airplane Co., Seattle
Ford Motor Co., 21 Buildings
Graybar Electric, Illinois
Inland Steel Building, Chicago
National Bank of Detroit, Detroit
Parke-Davis Bldg. 64, Detroit
Procter & Gamble Tech. Center, Cincinnati
Prudential Insurance Co., Newark
Travelers Insurance Co., Hartford

Write for detailed literature.

THE PYLE-NATIONAL COMPANY

MULTI-VENT DIVISION

WHERE QUALITY IS TRADITIONAL

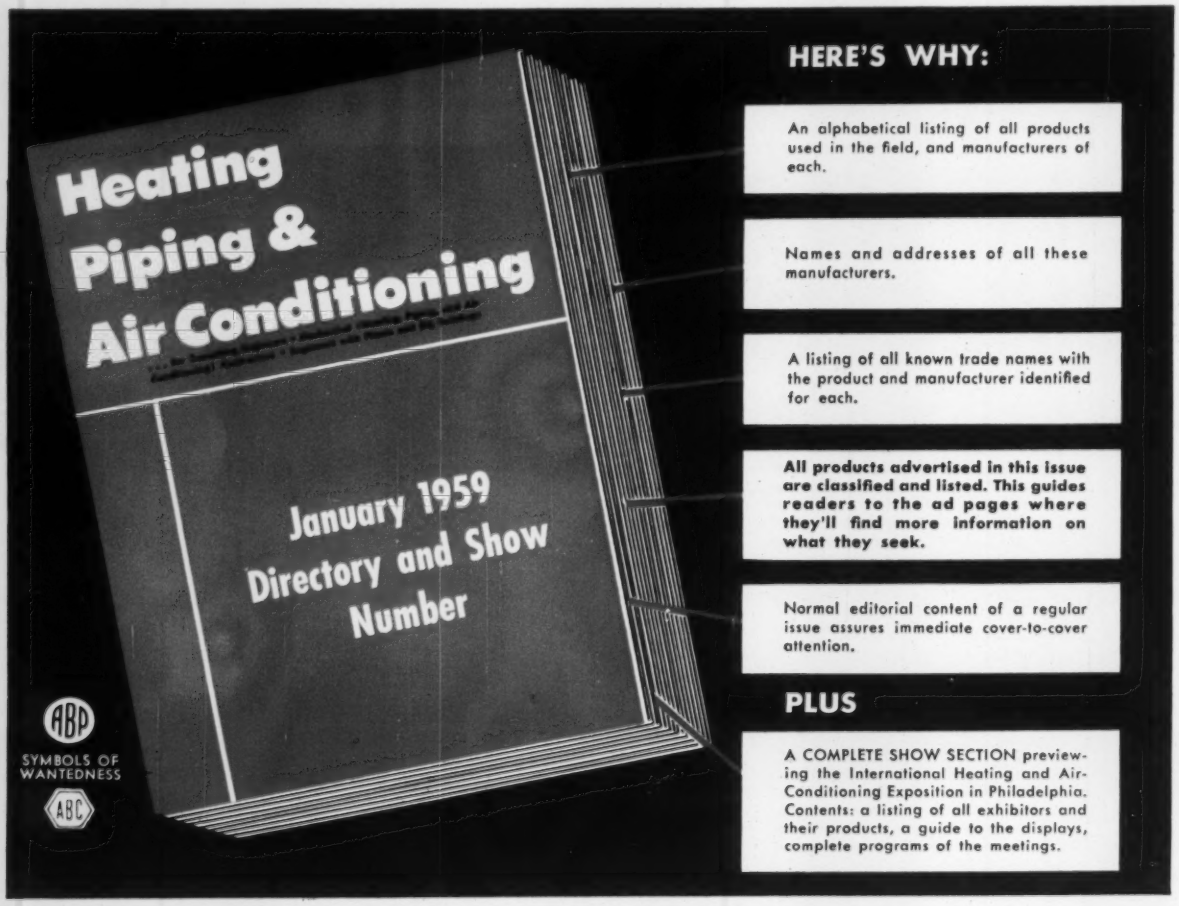
1373 N. Kostner Avenue, Chicago 51, Illinois

SALES AGENTS IN PRINCIPAL CITIES OF THE UNITED STATES AND CANADA

"Who makes it?" "Where can we get it?"

Since 1934 this annual Directory has given the answers to

CONSULTING ENGINEERS • MECHANICAL CONTRACTORS • ENGINEERS in INDUSTRIAL PLANTS • ENGINEERS in LARGE BUILDINGS


Heating
Piping &
Air Conditioning
January 1959
Directory and Show
Number
ABP
SYMBOLS OF
WANTEDNESS
ABC
HERE'S WHY:
An alphabetical listing of all products used in the field, and manufacturers of each.
Names and addresses of all these manufacturers.
A listing of all known trade names with the product and manufacturer identified for each.
All products advertised in this issue are classified and listed. This guides readers to the ad pages where they'll find more information on what they seek.
Normal editorial content of a regular issue assures immediate cover-to-cover attention.
PLUS
A COMPLETE SHOW SECTION previewing the International Heating and Air-Conditioning Exposition in Philadelphia. Contents: a listing of all exhibitors and their products, a guide to the displays, complete programs of the meetings.

This field's complete, authoritative Buyers' Guide. Regular space rates apply

Consider for a minute how our *all paid* subscribers (engineers and contractors *specializing* in heating, piping and air conditioning work) use this January Directory.

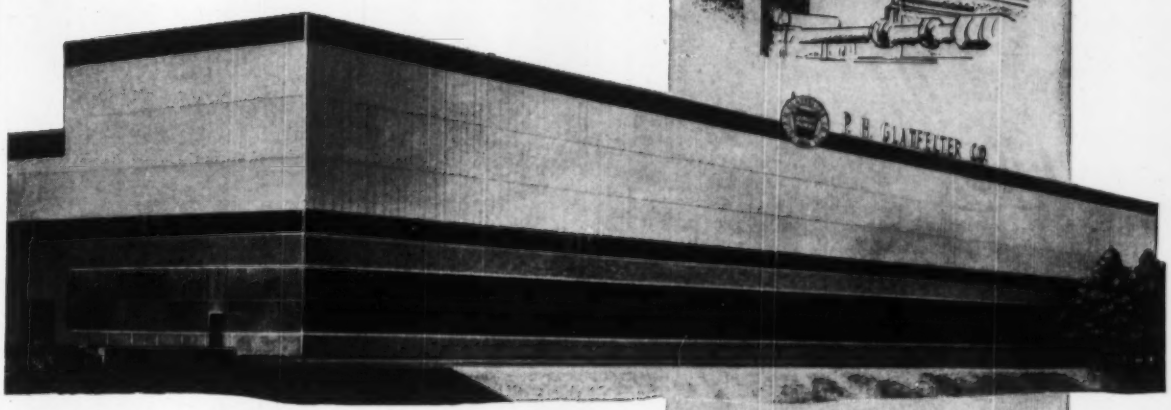
Take Mr. B. He's seeking your type of product. He's found those who make it. He's also discovered the firms who are advertising it in the very book he now has open. Wanting all the information he can get at that moment, he'll most certainly turn to these advertising pages.

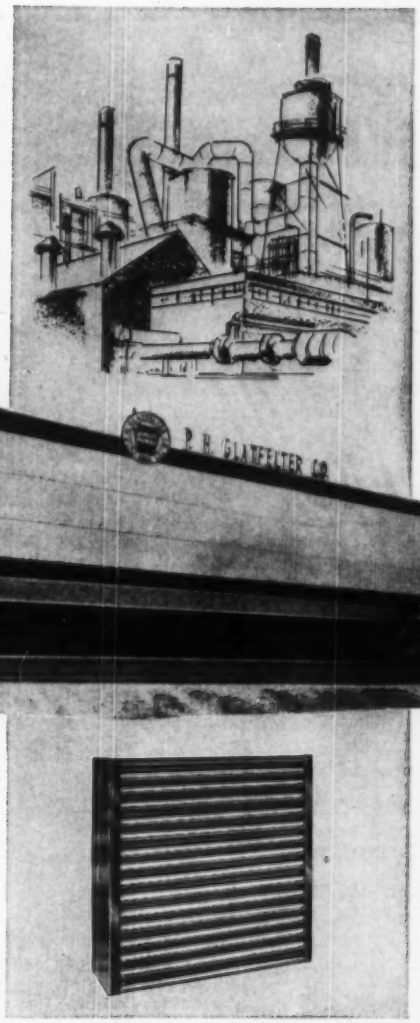
What an opportunity! Will you be there? Chances are your competition will be (nearly 300 advertisers appear each year). Make sure you will be, too. Reserve sufficient space to tell your full story, to parade your entire line. Remember, no premium is charged for this bonus-filled issue. It is not a 13th or extra-cost number. Act now. Closing date, December 10.

P.S. Here's *proof* of the lasting sales power of this field-specialized Directory: In a survey of our *all paid* subscribers, 96% report they keep this Directory throughout the year, 75% refer to the advertising pages as they use the Directory, and 91% regard the Directory as useful to them. Real value for them . . . real value for you!

Heating, Piping & Air Conditioning
KEENEY PUBLISHING CO. AIR CONDITIONING HEADQUARTERS
6 N. Michigan, Chicago

At the P.H. Glatfelter Paper Co....





AN AIR of MODERN DESIGN with dorex® Air Purification Equipment

The P.H. Glatfelter Company's new paper mill in Spring Grove, Penna., is an excellent physical expression of a growing trend in industrial architectural planning—modern exterior beauty matched by modern interior function.

Here, seventy-eight modern, soundly engineered Dorex Air Purification Cells were used to purify outside air and protect electrical equipment against destructive atmospheric properties.

Dorex equipment is specified and installed by leading architects and engineers because of matchless efficiency and the substantial savings on original investment and operating costs it permits.

With each installation Dorex assumes *complete* responsibility for economical, efficient operation. Choose Dorex . . . you'll find that prompt, experienced personal service is an important Connor product.

CONNOR... for Constant Comfort Conditions

Write for "Air Conservation Engineering"... the authoritative text on air purification.

CONNOR ENGINEERING CORPORATION

82 SHELTER ROCK ROAD • DANBURY • CONNECTICUT

CONNOR ENGINEERING CORPORATION

dorex® air recovery

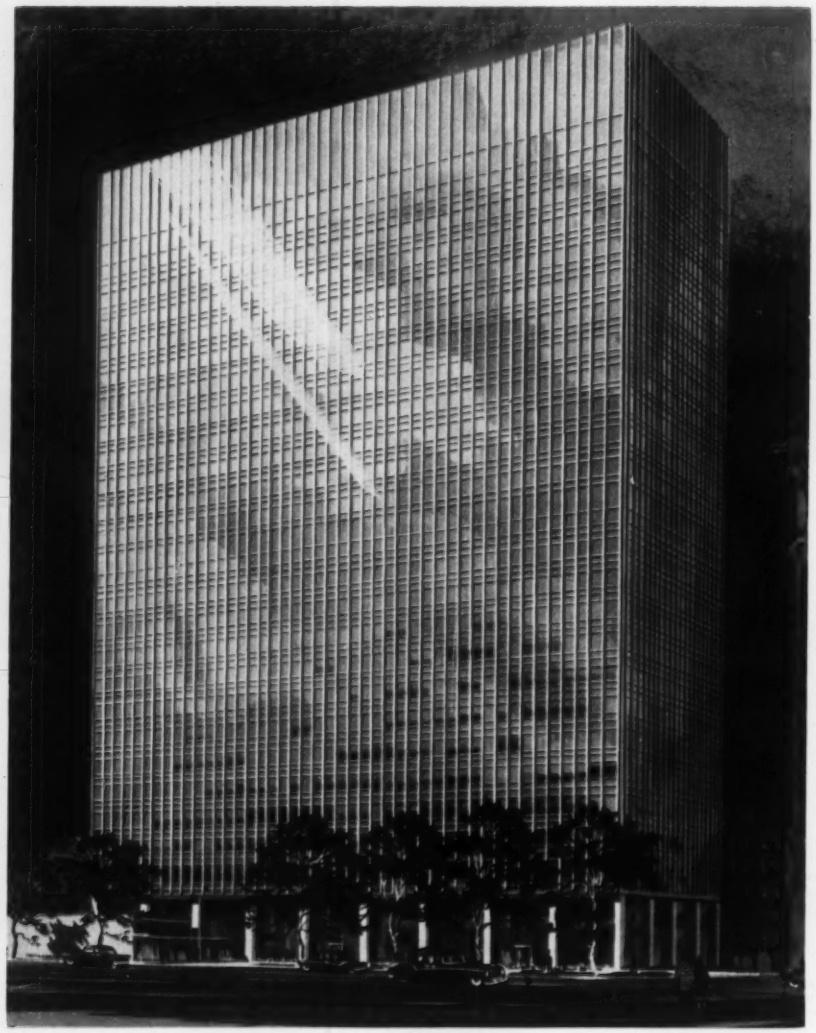
"The Illuminating Building"
Another modern

CLEVELAND LANDMARK

Equipped with

Yula

HEAT EXCHANGERS



Architect—CARSON and LUNDIN

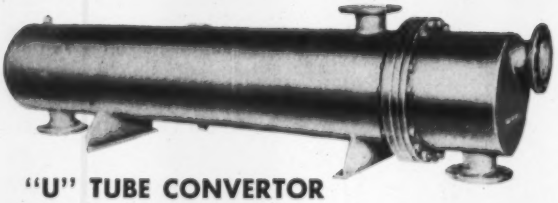
Consulting Mechanical Engineer—
JAROS, BAUM and BOLLES,
Chicago and New York

Mechanical Contractors—
KERBY SAUNDERS and THE FELDMAN BROS. CO.

Owners and Builders—
55 PUBLIC SQUARE

The convertor shown here is one of several furnished by YULA for this building. These heat exchangers are used for zone heating, interior reheat and condensate cooling. Fine buildings deserve fine equipment. Therefore, YULA was a natural selection for this one.

Equipment can be furnished "custom built" to meet specific requirements. Consult the YULA agent in your territory.



"U" TUBE CONVERTOR

Yula
HEAT-TRANSFER EQUIPMENT

YULA WATER HEATERS, INC. 330 BRYANT AVE., NEW YORK 59, N. Y.

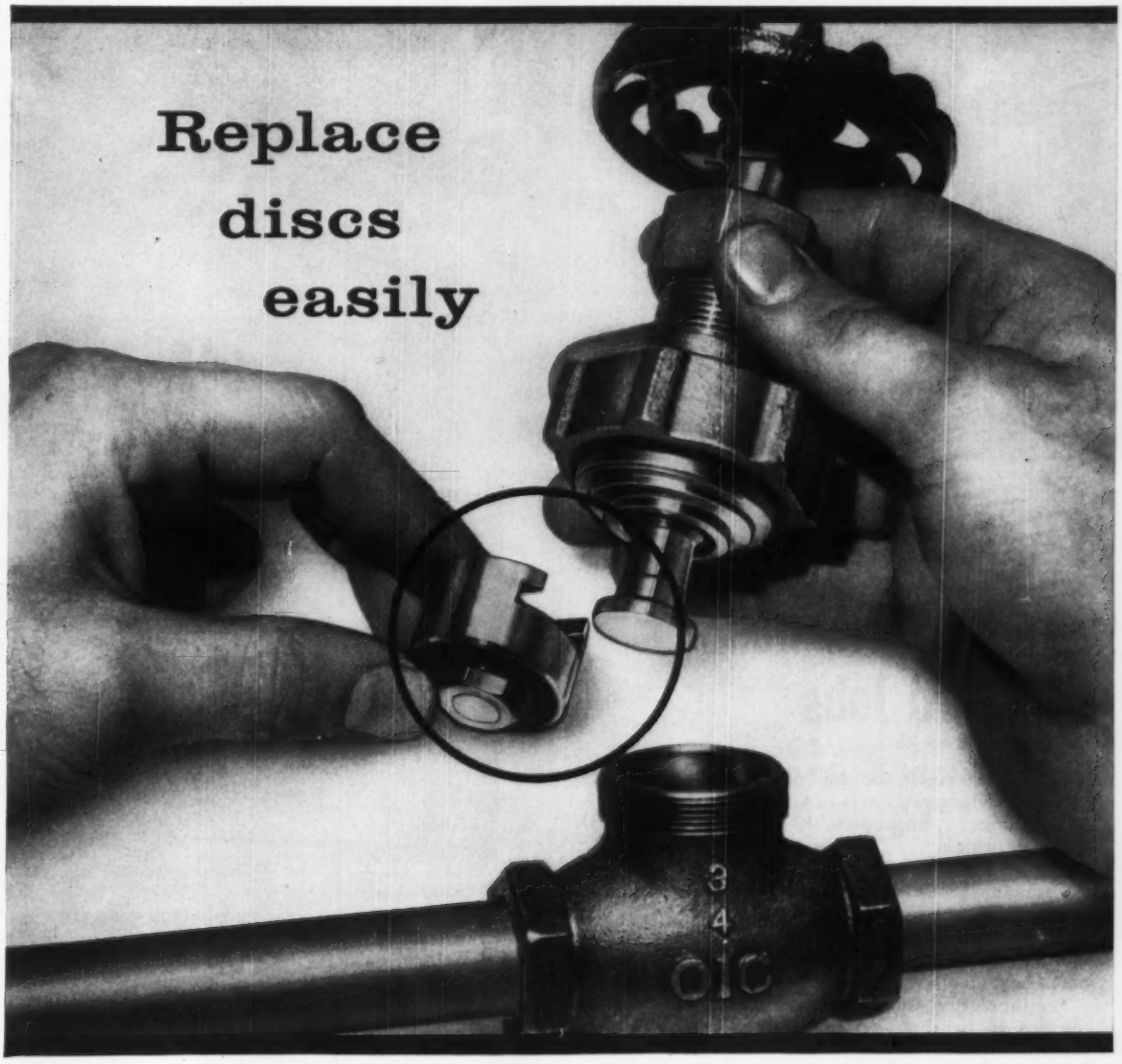


Fig. No. 520, 200 lbs. WSP, @400°F. 400 lbs. cold WOG, non-shock

It takes two minutes or less! Simply break the union joint and slip a replacement disc holder onto the button-head of the stem. Or, replace the disc only.

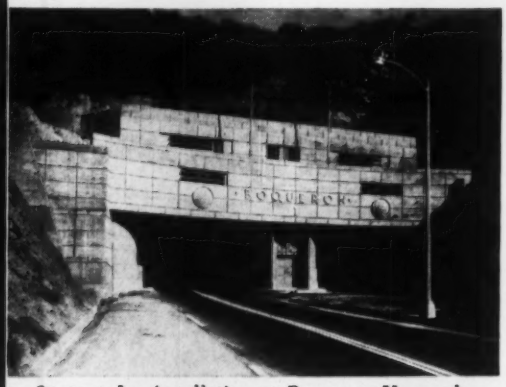
Additional features of this OIC line greatly reduce the need for other maintenance. For example: (1) The modern union body-bonnet joint assures a safe, tight, leakproof seal, which is not affected by frequent dismantlings. (2) The special OIC *alloy-40* stem material eliminates galling and seizing. (3) Molded, graphite-asbestos, plastic packing is used which seals without hardening or cracking in service.

Reduce your valve problems by installing this OIC line wherever you need bronze globe and angle valves with composition discs. Call your OIC Distributor for more facts, or write for Form No. 1001 which describes the entire OIC 500 line with composition discs, as well as spherical and plug-type discs in globes, angles and checks.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

VALVES | **FORGED & CAST STEEL, BRONZE & IRON VALVES**

The new Hampton Roads Tunnel uses 16 Joy Axivane Fans to move 3,406,000 cfm of both fresh and exhaust air.



Compact Joy installation at Boqueron, Venezuela, moves 3,952,000 cfm of air through a 1 mile tunnel.

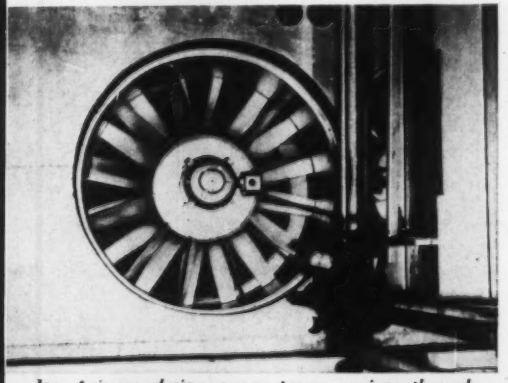
Ventilation Problems: JOY AXIVANE Handles the Hard Jobs

If you have a really tough ventilating job coming up . . . moving large volumes of air . . . variable pressures and volumes . . . unpredictable resistance . . . cramped space allotment . . . better take a look at the Joy Axivane Fans.

Compact design, with the motor *inside* the fan gives you more air per pound of fan and motor . . . more air per cubic foot of fan. The straight-thru design allows in-duct installation; becomes a *part* of the duct; eliminates offsets, elbows, drives and guards.

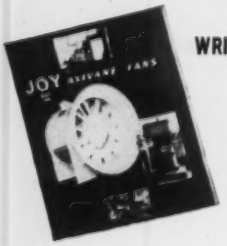
Pre-lubricated, double-shielded ball bearings permit the fan to be installed in *any* position. Adjustable blades allow for unpredictable resistance . . . permit changes in volume or pressure, *after* the fan is installed.

You choose from a standard line of over 136 models . . . and still have the advantage of Joy's custom engineering service. Joy Axivane Fans can make your next ventilating job a lot easier . . . one reason why Joy gets the tough assignments.



Joy Axivane design means power savings through adjust-in-motion blades at Alcoa's Texas Plant.

Dependable Joy installation circulates freezing air in California Cold Storage Plant.



WRITE FOR FREE BULLETIN 244-41

Get complete information about Joy Axivane Fans from **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

JOY ***SAVES YOU MONEY ON AIR***

COMPRESSORS • FANS • DUST COLLECTORS

WBW 1 5107-944

INLAND STEEL BUILDING, Chicago, Architects and Engineers: Skidmore, Owings & Merrill. Mechanical Contractor: Economy Plumbing & Heating Co.
FIRST FEDERAL SAVINGS
AAF
American Air Filter
COMPANY, INC., LOUISVILLE, KENTUCKY
American Air Filter of Canada, Ltd., Montreal, P. Q.

INLAND STEEL BUILDING

CHICAGO

EXTERIOR MATERIALS:
68% GLASS • 32% STEEL

INTERIOR CLEAN AIR:
100% AAF!

AAF ROLL-O-MATIC FILTERS selected for striking new Loop structure

The Chicago Loop's first major new structure in 20 years—The Inland Steel Building—features an innovation in air conditioning design. Conditioned air—supplied by five dual-duct high-velocity systems—travels through cellular steel floors to perimeter outlets.

To *clean* this air (totalling 285,600 cfm), Inland Steel turned to a well-known success formula: installation of AAF Roll-O-Matic air filters. Roll-O-Matics are completely automatic, need no attention other than replacement of media roll about once a year . . . and *that's* as simple as changing the film in a camera.

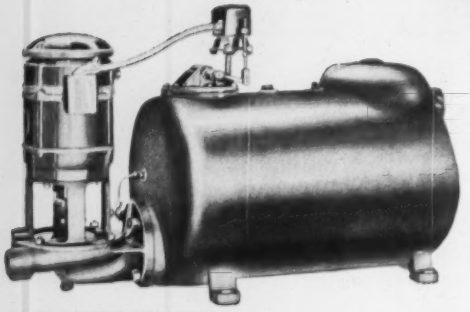
For complete information on the Roll-O-Matic automatic renewable-media air filter, call your nearest AAF representative or write direct for Bulletin No. 248-C. American Air Filter Company, Inc., 373 Central Ave., Louisville, Ky.

NO NEED FOR CUSTOM JOB

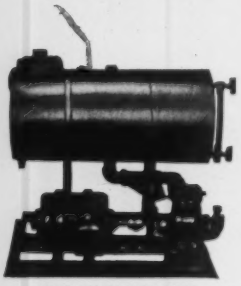
A standard type Skidmore Pump will meet the exacting requirements

"HS" CONDENSATE PUMP

4 ways . . . to improved pump performance!



"VC" CONDENSATE PUMP



"TM" TURBINE PUMP

"UV" CONDENSATE PUMP

- **TYPE "HS"**

  Sturdily constructed for dependable service at small investment — capacities 1,000 to 65,000 sq. ft. E. D.R., discharge pressures from 10 to 75 lbs.

- **TYPE "VC"**

  Ideal for handling hot condensate, unit operates quietly, and is easily accessible for inspection — capacities 1,000 to 65,000 sq. ft. E.D.R., and discharge pressures from 10 to 75 lbs.

- **TYPE "TM"**

  Completely assembled on either steel or cast iron base — capacities, for boilers up to 250 H.P., with discharge pressures to 150 lbs.

- **TYPE "UV"**

  Designed for low return installations — capacities, 2,000 to 40,000 sq. ft. E.D.R. and discharge pressures from 10 to 75 lbs.

Write for bulletins of the Skidmore Pumps listed above.

SKIDMORE CORPORATION

ST. JOSEPH, MICH.

Choose with Confidence!

Introducing the NEW MODEL 1-A SEVER-ALL Machine... CUTS AT 3 to 6 SECONDS PER SQUARE INCH—ECONOMICALLY

MANY EXTRA FEATURES AT A DELIVERED COST UNDER $500

You get the cut quality and capacity of machines nearly three times as expensive when you use the new Model 1-A SEVER-ALL oscillating dry abrasive cut-off machine. Available from your distributor's stock. Here's why the #1-A SEVER-ALL is ideal for industrial and machine shop operations:

BIG CAPACITY • Up to 2″ square solids, 3½″ O. D. pipe and tubing, 3″ angle iron, and 4″ channels . . . of cold rolled, stainless, and alloyed steel; cast iron; and nonferrous metals. Wheel oscillation, an exclusive feature in this price range, provides this *above-average* capacity.

SPEED • Cuts a 2″ x 2″ hardened steel bar in 16 seconds . . . other shapes and sizes at 3 to 6 seconds per square inch.

QUALITY • Clean, smooth cuts, even on large sections, because wheel oscillation provides cooler cutting.

ECONOMY • In addition to low initial cost, the Model 1-A SEVER-ALL is inexpensive to operate . . . occupies minimum floor space . . . requires little or no set-up time . . . eliminates annealing costs . . . gives more cuts per wheel because of oscillation.

SIMPLICITY • Just two SEVER-ALL cutting wheel specifications will do *all* your SEVER-ALL cutting jobs. A positive, screw-type vise holds all regular shapes, and an adjustable work stop provides speed and accuracy.

ANGLE CUTS • Optional accessory permits cutting angles up to 45° in either direction.

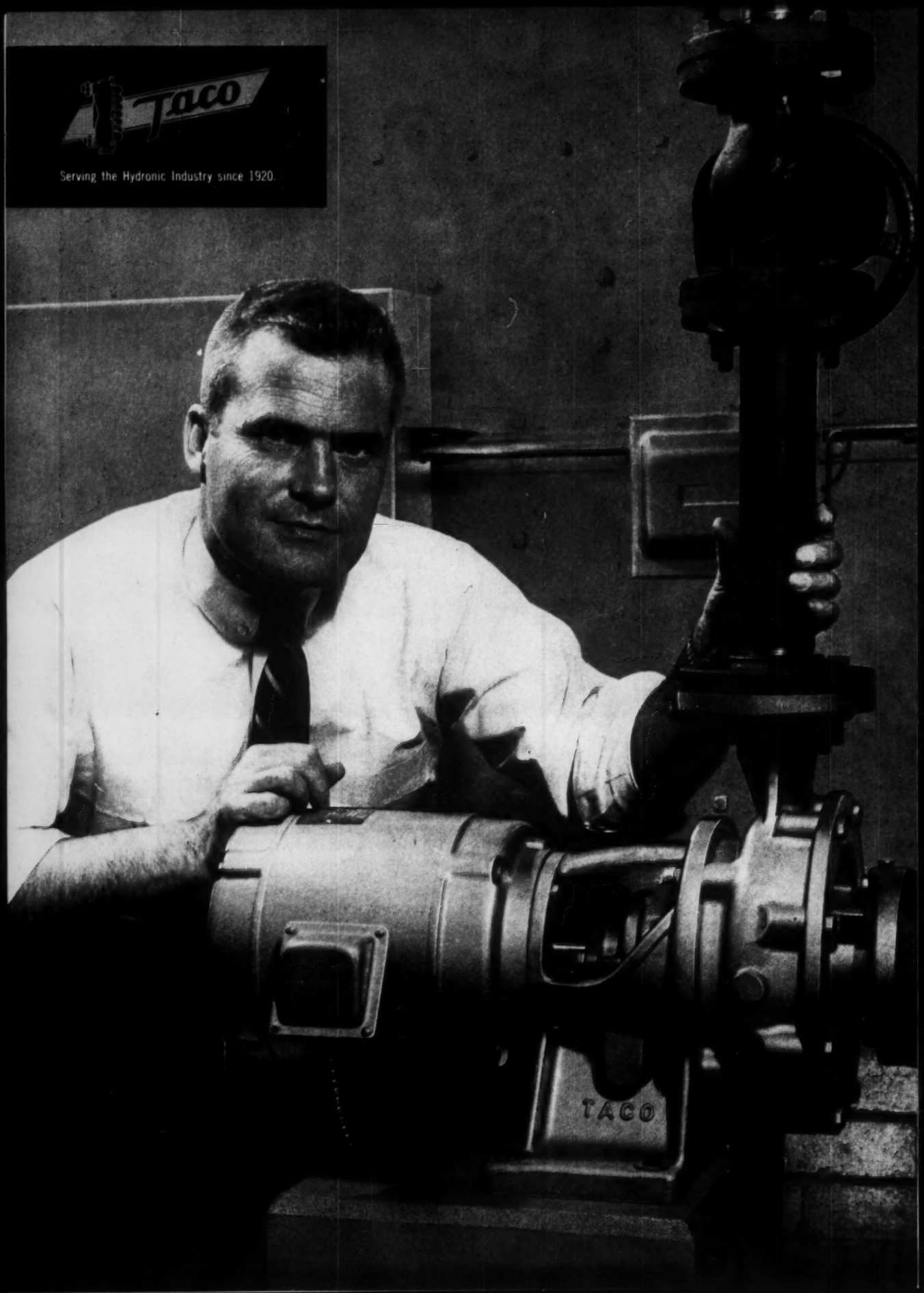
NEW SEVER-ALL AVAILABLE FROM DISTRIBUTORS

Very likely your own distributor already stocks the Model 1-A SEVER-ALL machine and wheels. If not, let us know, and we'll give you the name of your nearest SEVER-ALL distributor. Also, we'll be glad to send you complete details on this new machine. Just ask for **Bulletin DH-106.**

ALLISON-CAMPBELL DIVISION
AMERICAN CHAIN & CABLE

924-S Connecticut Avenue, Bridgeport 2, Conn.

ACCO


Taco
Serving the Hydronic Industry since 1920.
TACO

NEW from TACO

A LINE OF SINGLE STAGE CENTRIFUGAL PUMPS YOU DESIGNED!

On-the-job discussions with hydronic engineers, contractors and O.E.M. system designers . . . men who know what's needed in a pump . . . were basic factors in the final design and performance features of the new Taco LP pumps!

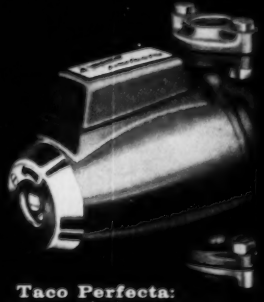
Here stated generally are the main features: rugged design; relatively few sizes; broad range of performance; high efficiencies; interchangeability of parts; available with stuffing boxes or mechanical seals. Also with special motor for extra quiet operation. For the specifics of this dynamic new pump series, write today for the Taco LP Pump Catalog.

Now, as in the past, "NEW from TACO" means the latest in better products for better pumping installations.

TACO HEATERS, INCORPORATED

1160 CRANSTON STREET, CRANSTON 9, RHODE ISLAND

Corporate Office: 342 Madison Avenue, New York 17, New York.
In Canada: Taco Heaters of Canada, Ltd., 4 Gilead Place, Toronto 2.



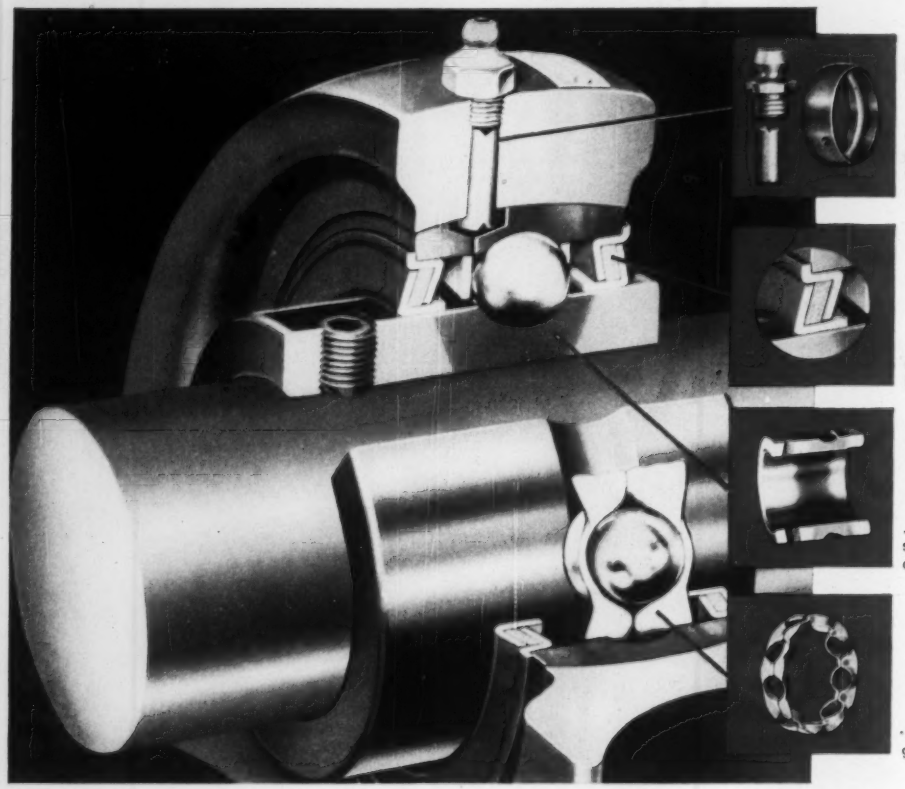
Taco Perfecta: the world's finest circulator; so quiet you won't believe it's running.

Taco Circulators: packed with quiet power and proven performance; sizes ¾" through 3".

Taco 170 Centrifugal Pumps: perfect for cooling tower jobs; air-conditioning installations . . . wherever a small, top-quality centrifugal pump is needed.

Smooth, Silent Air Conditioning Performance Depends on

SEALMASTER BALL BEARING UNITS



EXCLUSIVE COMBINATION OF FEATURES . . .

LOCKING PIN & PERIMETER DIMPLE

. . . permits selective fit between outer race of bearing and housing — an important feature that assures quiet bearing operation for air conditioning service.

LABYRINTH SEAL

. . . keeps dust and dirt out and lubricant sealed in, assuring long bearing life.

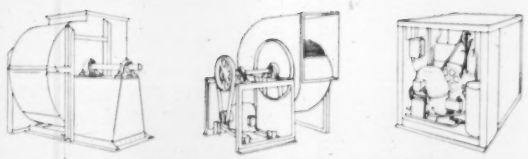
ZONE HARDENING

. . . assures positive race to shaft holding power. Reduces corrosion.

LAND RIDDEN BALL RETAINER

. . . minimizes ball wear, traps grease and prevents "churning."

An air conditioner — like any piece of equipment — becomes obsolete the day your competitor's product out-performs your own. It is for this reason that air conditioning engineers are continually involved in research to find ways to improve their product. It's the reason, too, that you find SEALMASTER Ball Bearing Units specified by many of the leading air conditioning manufacturers. SEALMASTER Ball Bearing Units, with their exclusive combination of patented engineering features, provide you with a decided performance advantage. It's the ball bearing unit line that's often copied but never equalled for performance.



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Write for catalog 454

SEALMASTER BEARINGS A DIVISION OF STEPHENS-ADAMSON MFG. CO. 47 RIDGEWAY AVENUE, AURORA, ILL.

JENN-AIR HI-D BELT DRIVEN CENTRIFUGAL AND AXIAL POWER ROOF EXHAUSTER

Hi-D MEANS HIGH DISCHARGE and LOWER ROOF MAINTENANCE

HI-D CENTRIFUGAL POWER ROOF EXHAUSTER
Unit in open position, showing ready access to drive assembly.

HI-D AXIAL POWER ROOF EXHAUSTER
Unit in open position, showing ready access to drive assembly.

New JENN-AIR aluminum belt-driven units meet industry's need for exhausters that combine high discharge with low contour appearance.

Often times it is advantageous to avoid direct discharge of air onto a built-up roof. Hi-D with no increase in curb height averages double the discharge height of ordinary fans. It likewise offers advantages in areas where drifted snows require higher discharge height. Ordinarily this would mean the use of higher curbs and unsightly projection above the roof line. Once you compare, you will decide on Jenn-Air.

JENN-AIR PRODUCTS COMPANY, INC.
1102 Stadium Drive, Indianapolis 7, Indiana

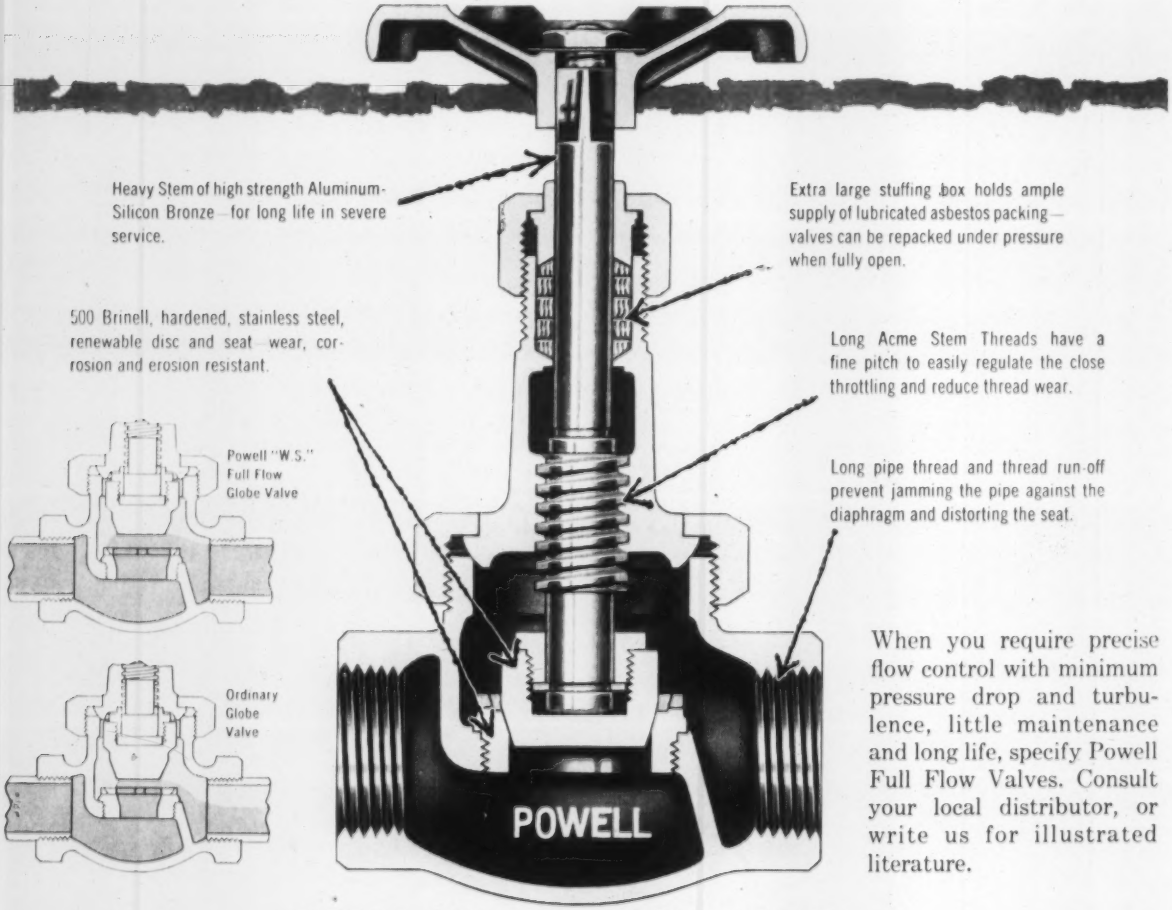
BULLETIN!

POWELL introduces new member in world's largest family of valves

Powell engineered "Full Flow" bronze valves are now available in a full line: the brand-new 150-pound screwed end Globe Valve, in addition to the well-known 200-300 pound Screwed and the 150-300 pound Flanged Globe and Angle Valves.

Although designed by Powell to assure maximum flow with minimum pressure drop and internal turbulence, these valves can be throttled to permit only the minutest amount of fluid to pass through. And, if desired, they can be supplied with Indicator Collar, Arm and V-port Disc for quickly determining flow and holding it constant.

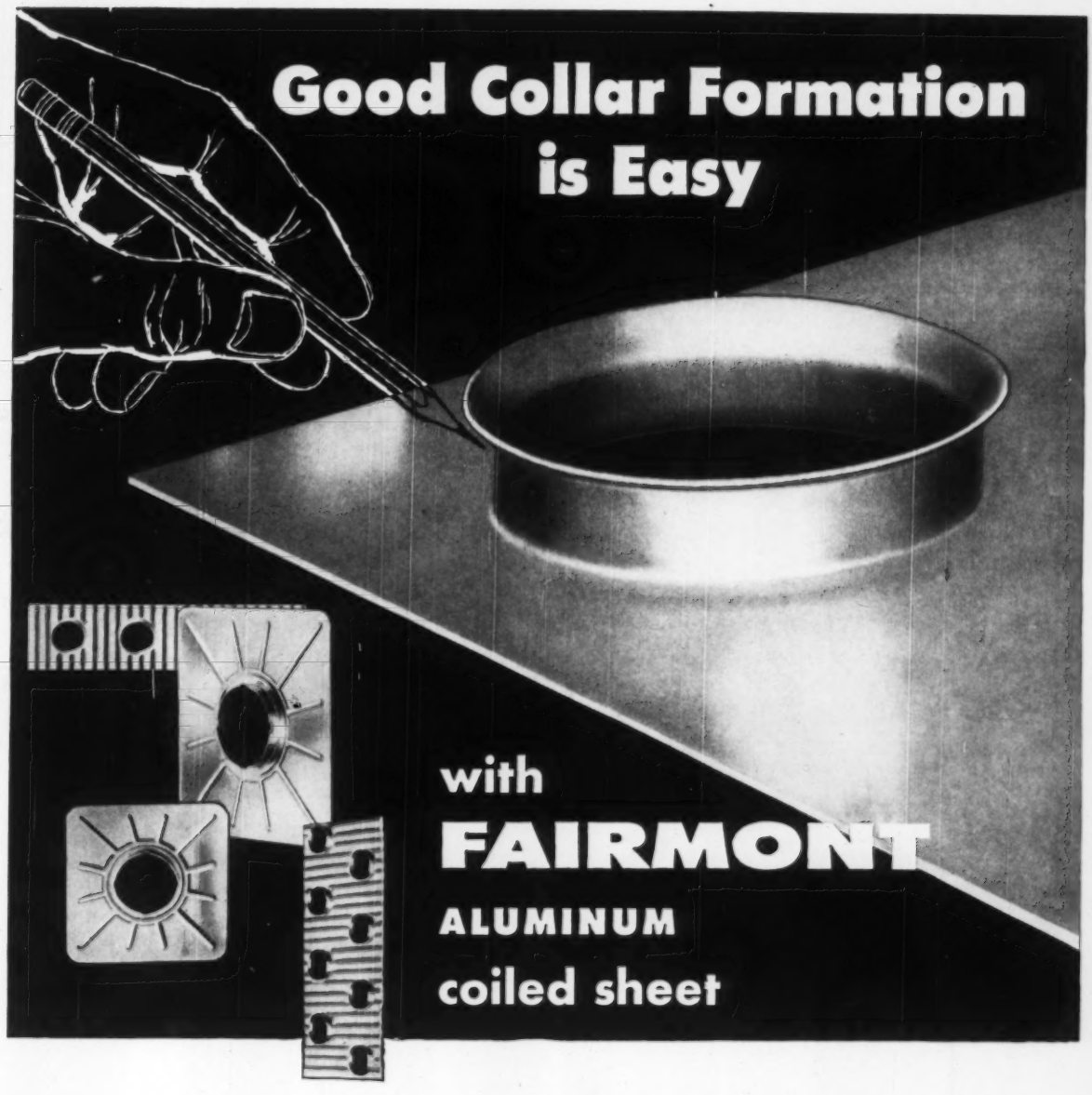
Compare these advantages of Powell Full Flow valves:


Heavy Stem of high strength Aluminum-Silicon Bronze—for long life in severe service.
Extra large stuffing box holds ample supply of lubricated asbestos packing—valves can be repacked under pressure when fully open.
500 Brinell, hardened, stainless steel, renewable disc and seat—wear, corrosion and erosion resistant.
Long Acme Stem Threads have a fine pitch to easily regulate the close throttling and reduce thread wear.
Long pipe thread and thread run-off prevent jamming the pipe against the diaphragm and distorting the seat.
Powell "W.S." Full Flow Globe Valve
Ordinary Globe Valve
POWELL

When you require precise flow control with minimum pressure drop and turbulence, little maintenance and long life, specify Powell Full Flow Valves. Consult your local distributor, or write us for illustrated literature.

Fig. 2600 (Sectional)—150-pound "W.S." Full Flow Globe Valve, Screwed Ends

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**



When choosing aluminum coiled sheet for heat transfer products, alert manufacturers demand deep-drawing, non-earing stock for rapid as well as uniform forming of collars without cracking or buckling. Close adherence to required gauge tolerance is of prime importance in manufacturing cost.

The low-cost, highly efficient product you've made from Fairmont aluminum will give years of use to satisfied customers, because Fairmont aluminum resists corrosion and breakdown.

Along with rigid quality control, Fairmont offers "individualized" attention to manufacturers' requirements for coiled and flat sheet in 1100, 3003, 5005, 5050 and 5052 alloys. Let us show you why Fairmont aluminum is being specified by the foremost heat transfer product manufacturers. Write or call today for details.

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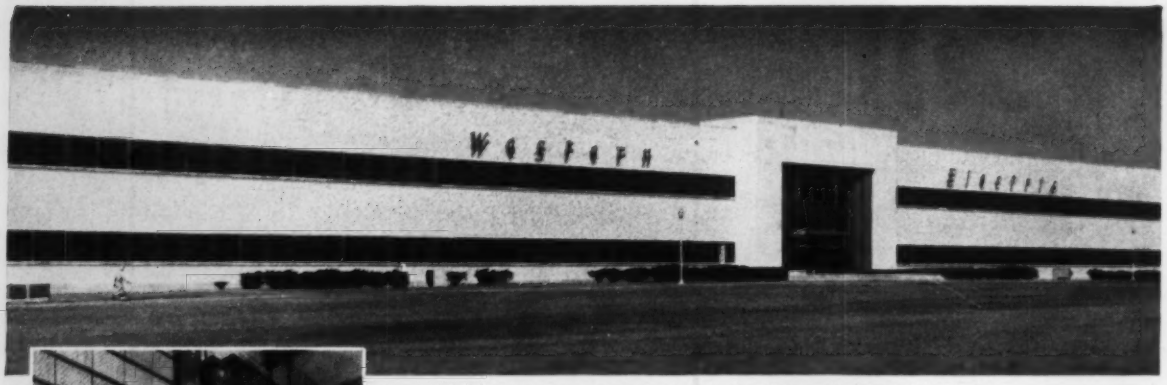
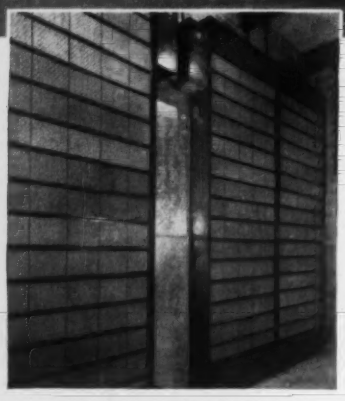


New MERRIMAC VALLEY PLANT of WESTERN ELECTRIC COMPANY, North Andover, Massachusetts.

Architects-Engineers: Western Electric Company
Associate Architects-Engineers: Charles T. Main, Incorporated
Sheet Metal Contractor: C. P. Blouin, Incorporated
General Contractor: Turner Construction Company



Partial view of Continental Self-Cleaning Automatics in one of nine identical fan rooms.

Glimpse into one of 15 similar penthouses showing Continental Self-Cleaning Automatics in use.

CONTINENTAL *clears the air*

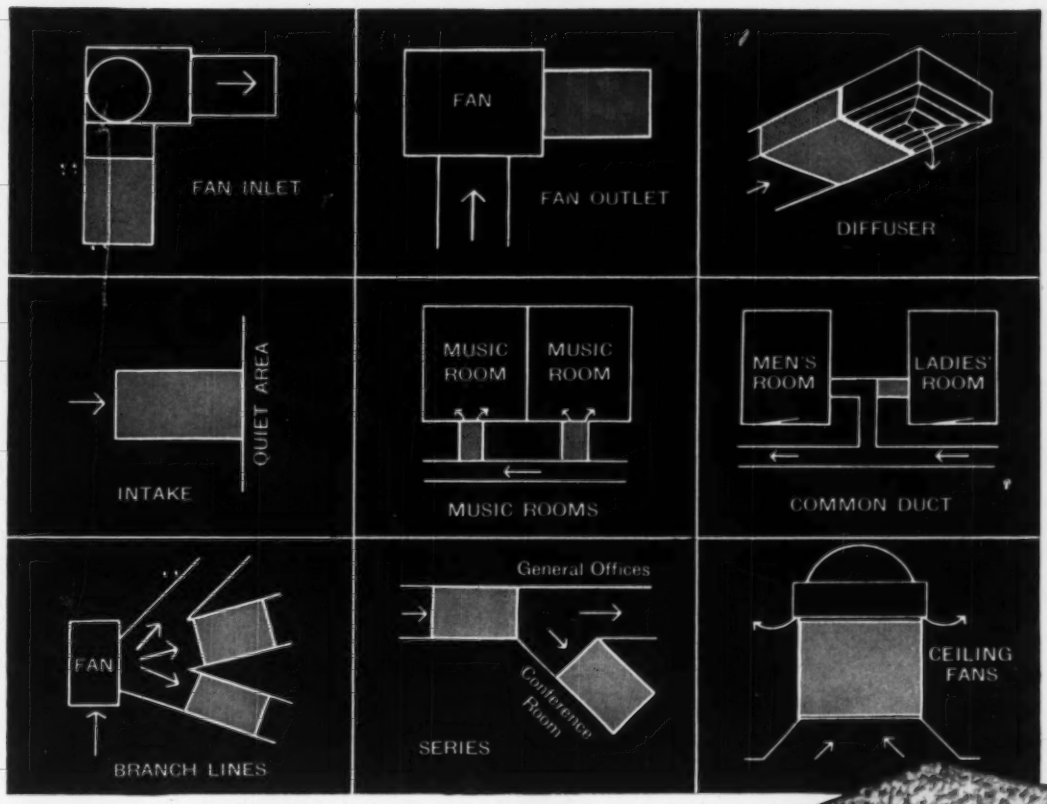
for this new plant of

WESTERN ELECTRIC

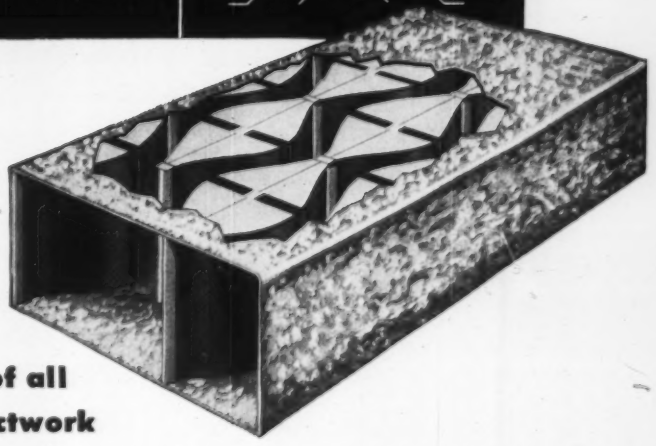
Western Electric's huge new Merrimac Valley Plant combines under one roof many manufacturing operations which had previously been scattered in small units throughout the area. One million square feet of manufacturing space is provided.

For winter heating and summer cooling, Continental clears the air with Self-Cleaning Automatic Air Filters located in 29 different fan rooms throughout this most modern industrial building to handle a total of 2,273,200 cubic feet of air per minute.

Whatever *your* air cleaning requirements, choose one of the many types of Continental air filters to clear the air for you. You will find the Continental representative in your area a willing source of information . . . or write direct.



Every Building Needs *Aircoustat* Sound Traps



AIRCOUSTAT silences all noise of all frequencies traveling through ductwork

Eliminate disturbance, distraction and irritation caused by noises escaping from one area to another through ductwork.

Install AIRCOUSTAT Sound Traps. AIRCOUSTAT eliminates guesswork, wasted space and unnecessary expense of duct lining. You can guarantee your client trouble-free performance. You can estimate with complete confidence the performance of particular applications. If AIRCOUSTAT fits geometrically, it fits acoustically.

AIRCOUSTAT saves you space. Its greater effectiveness permits smaller-sized ducting. It eliminates bulky mufflers.

For more details, write to KOPPERS COMPANY, INC., Industrial Sound Control Dept., 6211 Scott Street, Baltimore 3, Md.

KOPPERS

INDUSTRIAL SOUND CONTROL

Engineered Products Sold with ***Service***

PETRO *SuperCharger* OIL BURNER

HAS THESE THREE ADVANTAGES

1 Fires low cost heavy oils in medium size heating plants.

2 Forced draft firing eliminates high stacks.

3 Control panel, firing and draft mechanism in single, compact unit, factory wired and tested. Entire combustion system installed by bolting to boiler front.

LOW COST HEAVY OILS FIRED WITH COMPLETE DEPENDABILITY
Heavy oils, including No. 5, can now be fired with complete dependability in a gun type burner and with as little maintenance and supervision as a residential oil burner. The SuperCharger atomizing principle reduces even No. 5 oil to a vapor-like mist, using the self-generated heat resulting from compression of the air-oil mixture, to produce the highest degree of heavy oil atomization ever achieved.

NO GAS PILOT NEEDED—STARTS WITH ELECTRIC IGNITION
Ignition is positive, instantaneous and dependable. No complicated pre-purge gas safety controls required. Eliminates the need for expensive and involved gas piping.

LOW FIRE STARTS—FULL MODULATION
The Petro SuperCharger burners are available in models with:
1. Fixed firing rate that can be manually adjusted at any level desired.
2. Two-position firing with low-fire start.
3. Fully automatic modulation, with firing rate constantly adjusted to the load.

COMPLETE BOILER-BURNER UNIT—OR BURNER ONLY
Can be ordered as a complete boiler-burner unit, with Scotch boiler and forced draft fan, ready for service connections. Also available as a conversion burner which can be applied to any boiler, for either natural, forced or induced draft.

For more information and specifications, please mail the coupon, or see Petro Catalog in Sweet's Architectural File.

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Makers of quality heating and power equipment since 1903

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Please send me more information on the new Petro SuperCharger Burner.

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WEIRKOTE® — THE RIGHT CHOICE BY EVERY MEASURE

No matter what the specifications of your heating or air-conditioning duct work, Weirkote will meet them as only a quality zinc-coated steel can. No other metal can match it.

Take, for instance, the strength and rigidity of Weirkote. It's a natural for spanning large areas without bending or buckling and with a minimum use of supporting brackets. Consider, too, its fire protection. Its higher melting point makes it provably safer than competing metals. Since ducts sometimes carry volatile matter with a low flash point, this protection can be vital.

Important, too, is Weirkote's economy. Made by the continuous process which integrates zinc and steel, Weirkote can be worked to the very limits of the steel itself without flaking or peeling. Permanent corrosion resistance is provided in every seam and surface. Which, of course, all adds up to longer, maintenance-free life for Weirkote ducts. And its ease of installation cuts cost still further.

After a Weirkote duct installation is in and operating, your clients will find still another reason to be glad you specified Weirkote—it's quiet. Noisy creaks and cracks of expansion and contraction are minimized. With all these advantages plus economy, you just can't go wrong with Weirkote.

Free Weirkote Booklet

Send for the new booklet on Weirkote today. Write Weirton Steel Company, Dept. M, Weirton, W. Va.

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"B&W's Mr. Tubes gives me the 'extra' help I need to engineer for profit!"

YOU can ENGINEER FOR PROFIT by keeping your piping costs as realistic as possible. Specifying and buying welding fittings and pipe, especially the alloys, can be pretty tricky. Admittedly, most alloy jobs are, inherently, both complex and expensive. Any error in judgment can throw costs way out of proportion. That's why it pays to call in B&W's Mr. Tubes. Put him on your planning team . . . he's the man that can help make your specifying decisions more certain.

As your local B&W representative, Mr. Tubes is well qualified to give you the kind of technical help you need to hold your alloy piping costs to a minimum. He can offer dependable help in selecting the most economical grades and sizes best suited for your end-use applications.

And, through Mr. Tubes, you can save both time and money by utilizing B&W's "one-source" supply. You get a matched piping system — both pipe *and* fittings, in the materials you need — when you need them. Buying and delivery are more closely controlled, too. Check with Mr. Tubes on your next job. He can be reached at any B&W Tubular Products Division District Sales Office. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

TA-8032-G5

Seamless welding fittings and forged steel flanges, seamless and welded tubular products, solid extrusions — in carbon, alloy, stainless steels and special metals.

IT TAKES a lot of juggling of many factors to arrive at the best design for a power piping system. How is the piping sized? How is its wall thickness determined? What special fabrication and installation techniques are used? See page 95.

A new shopping center's structural limitations made the design of its heating system a tough job. The result is a unique "tailor-made" HTHW system. See page 112.

Big savings in winter heating costs in industrial plants can be effected through heat recovery and conservation systems. How are these systems designed? See page 123.

Building Contract Trend Indicates Rosy Future

. . . 5 percent ahead of last year

AUGUST CONSTRUCTION contracts in the U. S. totaled $3,466,576,000, an increase of 23 percent above the same month of last year, according to F. W. Dodge Corp.

Large increases occurred in nearly all the major classes of construction, the firm reported, with the only sizable exception occurring in manufacturing buildings.

According to Dodge vice chairman Thomas S. Holden, the past four months have been the highest ever reported. "These recent record volumes of contracts," he said, "accent in very positive terms the resumption of the nation's postwar growth trend. Growth potentials are strong, indicating continuing construction demand for some time to come. Recent improvement in private construction activity is a particularly favorable factor."

Contracts for privately owned projects in August were 11 percent above August 1957, although declines earlier in the year have kept the total for the eight months to date 3 percent below the corresponding period of 1957. Public ownership contracts were up 54 percent in August and 19 percent for the eight month period.

Contracts for nonresidential buildings in August totaled $1,078,938,000, an increase of 7 percent over August 1957.

August residential building contracts amounted to $1,450,576,000, a gain of 13 percent over the corresponding month of last year. The August contracts covered 113,460 dwelling units, a gain of 17 percent over the year-ago figure.

Heavy engineering contracts in August were $937,062,000, up 78 percent from August 1957.

Totals for the first eight months of 1958, with percentage changes from the corresponding period of last year, are: nonresidential, $7,624,337,000, down 4 percent; residential, $9,500,035,000, up 5 percent; heavy engineering, $6,674,136,000, up 17 percent; total construction, $23,798,508,000, up 5 percent. ≠

Bright Horizon Pictured At 23rd Power Show

. . . December 1-5

AN INDUSTRIAL panorama has been created for the 23rd National Exposition of Power and Mechanical Engineering, at the New York Coliseum, December 1-5. Forecasting the business expansion predicted for 1959, it will portray the methods and mechanisms whereby the manufacturing industries will be able to increase productivity with economic advantage.

The exposition, held under the auspices of the American Society of Mechanical Engineers in conjunction with its 1958 annual meeting, will be open to members of the society and guests associated with the power and related mechanical fields, exclusive of the general public.

For information, write: E. K. Stevens, exposition manager, International Exposition Co., 480 Lexington Ave., New York 17.

The field of power and mechanical engineering will be featured by Alex Dreier, noted news analyst and commentator, on a nationwide radio program on Sunday, November 30, Mr. Stevens reports.

The program, "America on the Go," will be broadcast at 6:05 p.m. (EST) over the entire NBC network of nearly 200 stations. Mr. Dreier's tribute will tie in with the exposition. ≠

NEMA Gives IRS Position On Proposed Rule Changes

. . . affecting room air conditioners

THE Internal Revenue Service has been asked by the room air conditioner section of the National Electrical Manufacturers Association to adopt a newly developed industry definition for self-contained air conditioning units, as well as to consider three key requests in connection with proposed IRS revisions of Internal Revenue Ruling 54-462.

Under the proposed ruling, IRS would make all "self-contained air conditioning units" subject to the 10 percent manufacturers excise tax, instead of only those under 1 hp as presently taxed.

The foregoing representations were made to IRS recently at a meeting be-

tween representatives of IRS and the NEMA section's excise tax committee.

In their discussions with IRS, excise tax committee members stated that the revised ruling on self-contained air conditioning units should include language that will clearly limit the tax to what are known in the industry as room air conditioners. Such units, the NEMA committee said, are correctly defined as follows:

"A self-contained air conditioning unit subject to tax under Section 4111 of the Code is limited to the type of unit known in the industry as a room air conditioner, which is a factory-made encased assembly, or one sold for assembly on installation, designed as a unit primarily for mounting in a window or through a wall or for use as a portable or as a console unit. These units are designed primarily to provide direct delivery of cooled air, without ducts, to an enclosed space, room, or zone. They include a prime source of cooling and means for circulating, dehumidifying, and cleaning air, and may also include means for ventilating.

"Certain units incorporate components or parts to provide a means for heating the air. Examples of such units and the tax consequence are indicated below:

"1) Units which furnish heat by means of electric resistance heating elements. These are partially taxable as self-contained air conditioning units.

"2) Self-contained air conditioning units designed specifically for heating and cooling through reversal of refrigerant or air flow are not taxable articles under the purview of Section 4111 of the Internal Revenue Code."

In addition, NEMA requested that the ruling be made effective on November 1, 1958, and that:

1) Self-contained air conditioning units sold for future delivery under builders' contracts made prior to the effective date of the new definition be excluded from taxation under the revised ruling, and

2) The definition of the units specifically exempt from taxation sleeves or shells furnished to builders by manufacturers of room air conditioners. This exemption is requested on the basis that these are architectural structural items rather than integral parts of a self-contained air conditioning unit. The installation of sleeves or shells does not necessarily mean that air conditioning units will be installed therein, this generally being left to the later option of the occupants.

IRS is giving consideration to the various requests made and has asked the NEMA Section for additional clarification of its position, that "self-contained air conditioning units designed specifically for heating and cooling through reversal of refrigerant or air flow" should be exempt from the application of the tax. Also it requested further information on reasons for asking that self-contained air conditioning units "sold for future delivery under builders' contracts made prior to the effective date of the new definition" be exempt. ≠

ABS Plastic Pipe Standards Proposed

. . . copies available while they last

THE U.S. DEPT. of Commerce has presented to the industry for consideration three recommended commercial standards for acrylonitrile-butadiene-styrene (ABS) plastic pipe proposed by the Society of the Plastics Industry, Inc., according to the Dept.'s Commodity Standards Div.

The titles of the specifications are Rigid ABS Plastic Pipe, IPS Dimensions, TS-5423; Dimensions and Tolerances for Solvent Welded (SWP size) Rigid ABS Plastic Pipe, TS-5424; and Dimensions and Tolerances for Lightweight Rigid ABS Plastic Pipe, TS-5425.

Those interested may obtain copies, while they last, from H. A. Bonnet, Commodity Standards Div., Dept. of Commerce, Washington 25, D.C. ≠

Gas Utility, Pipe Line Sales Show Annual Gain

. . . up 5.6 percent

THE GAS UTILITY and pipe line industry's sales for the year ending July 31 totaled 79.1 billion therms to show an annual gain of 5.6 percent, the American Gas Association reports.

While the industry's total July sales of 4860 million therms was off 1.9 percent from a year ago, the nation's industrial production, as measured by the Federal Reserve Board index, fell 8.3 percent under the index for the corresponding month in 1957.

Sales of manufactured and mixed gas in July showed an annual gain of 2.7 percent, totaling 108.7 million therms. Natural gas sales of 4752 million therms during the month were off 2.0 percent from last July. ≠

When Delegating Jobs, Choose Right Employees

. . . cite five tips to finding right man

A GOOD manager will try to train his employees by delegating responsibility and make work assignments that will develop unused ability. Dr. Donald A. Laird, former head, psychology department, Colgate Psychological Laboratory, says, "To find out if a man is able to handle a job, give him a crack at it. This direct approach is not without risk, but the risk can be minimized by such expedients as making the first delegations brief and self-terminating."

Here are five tips to guide you:

1) Find the man with unused abilities

2) Delegate to a wide range of people

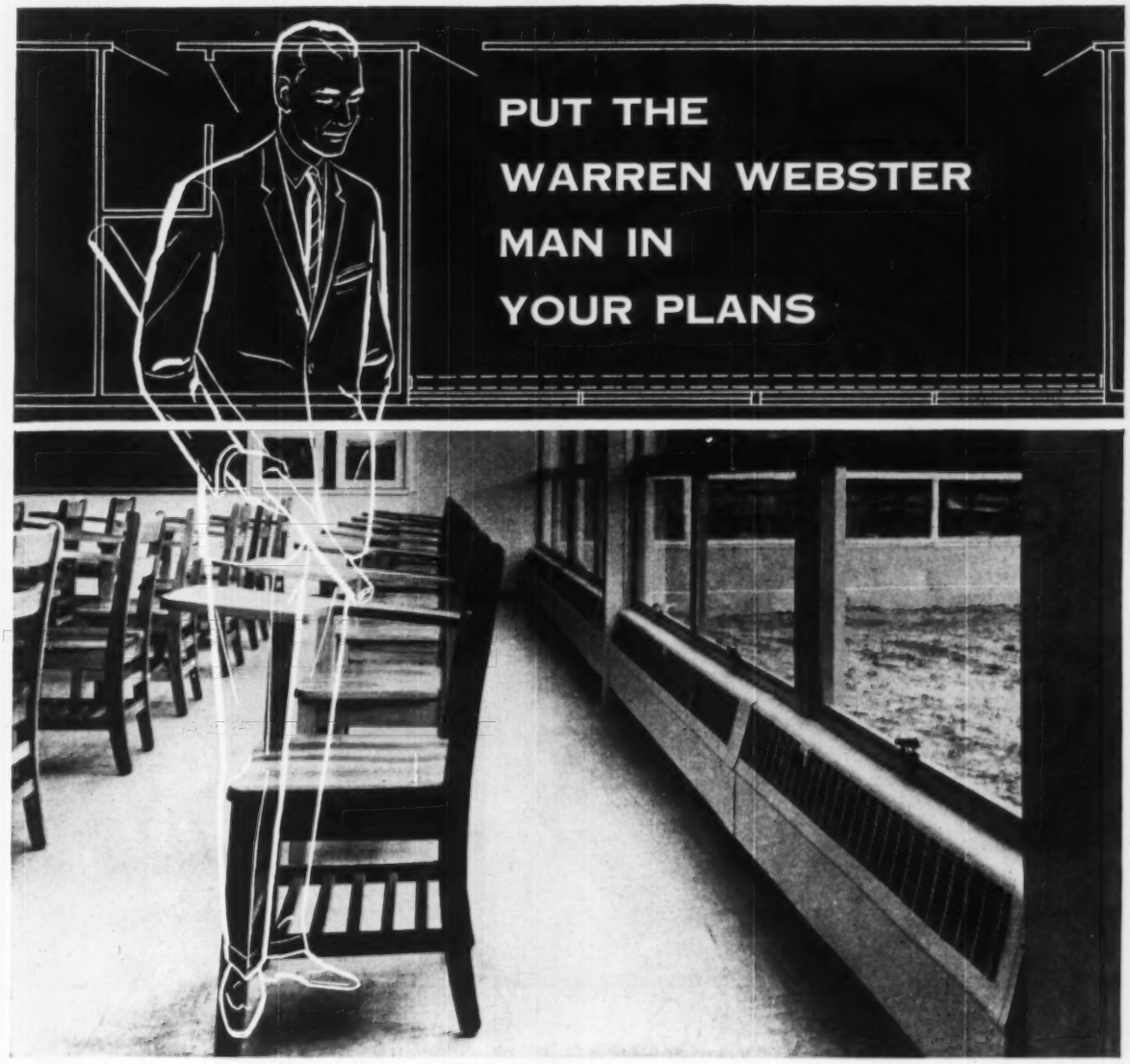
3) Find the not-so-obviously qualified individual

4) Find the man with a weakness

5) Delegate to the problem employee. ≠

"Quote"

"We must restructure our engineering education to provide three levels of training to keep abreast of current demands for scientifically trained personnel: (1) the two-year technical institute to train men for installation and testing; (2) the regular four-year program for those who will be in design and engineering positions; and (3) the seven-year doctoral program to prepare those capable of becoming inventors and basic research executives."—*Dr. Eric A. Walker, president, Pennsylvania State University, at the recent dedication ceremonies of National-U.S. Radiator Corp.'s new engineering center and research park at Johnstown, Pa.*



Walvector Stretches Out Your Heating Dollar

Where low operating costs and high comfort heating are major considerations, Webster Walvector meets every specification. Fuel dollars go farther, because Webster Walvector eliminates hot-and-cold spots, ends drafts, spreads uniform clean heat without waste.

Installation dollars go farther, too. Long lengths go in fast . . . trim pieces and accessories take care of offsets, jogs and bays. You need fewer risers . . . a minimum of piping . . . and no hung ceilings or furred columns to hide piping.

Yes, your heating dollar goes farther, more comfortably, when your Warren Webster Man puts Webster Walvector in your plans. Ask him for the exciting details. Or write for Bulletin B-1551. Warren Webster & Company, Camden 5, New Jersey. Since 1888. Offices in principal U.S. cities and Canada.

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FINEST
PRODUCT

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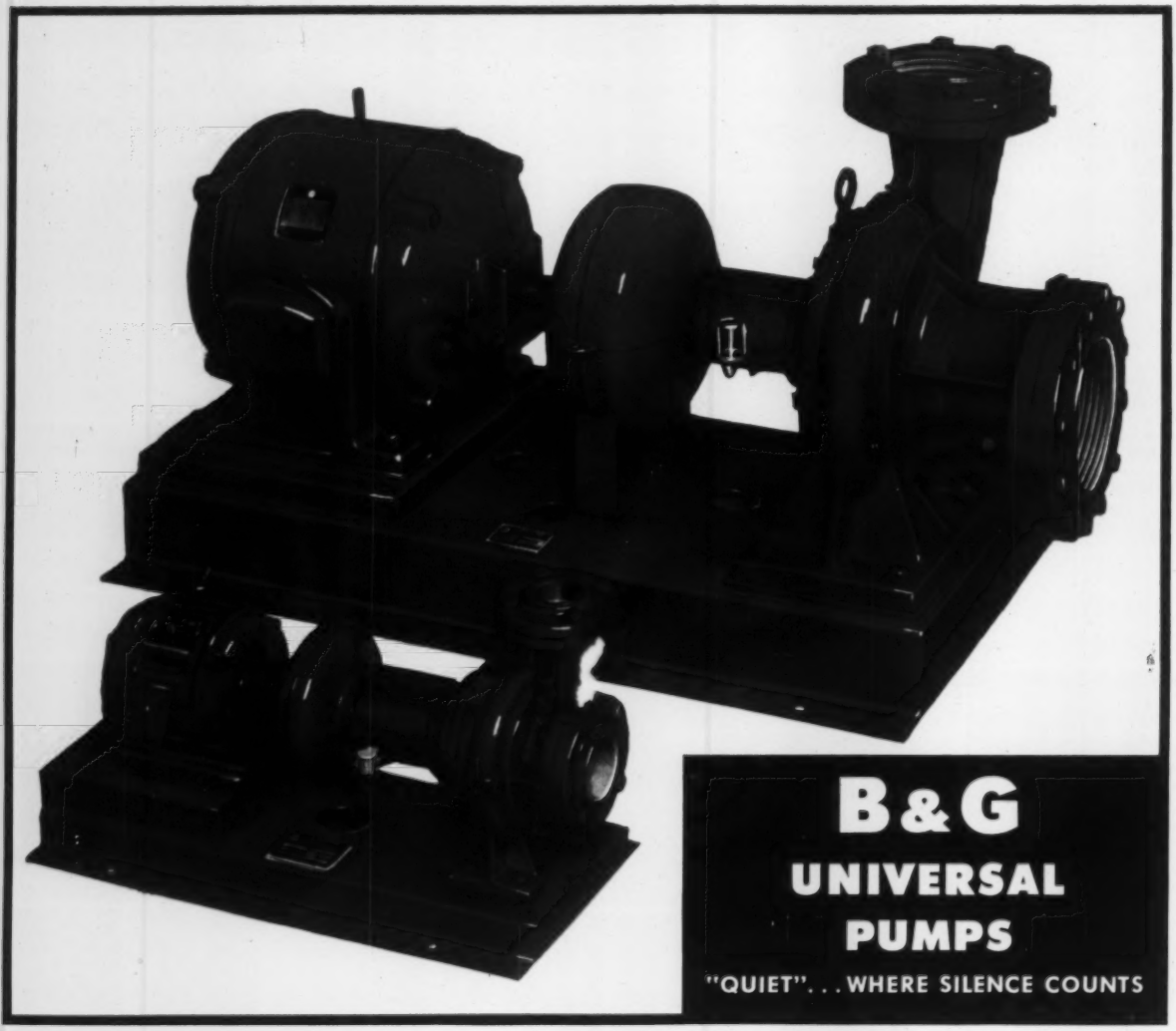
WARREN WEBSTER

HEATING . . . COOLING



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UNIVERSAL
PUMPS
"QUIET"...WHERE SILENCE COUNTS

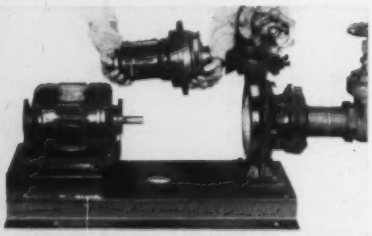
QUIET... FROM 1 TO 40 H.P.

With the line of B&G Universal Pumps now covering a range of from one to forty horsepower, every conceivable circulation requirement of systems using water for heating and cooling can be satisfied.

The B&G Universal Pump is an outstanding example of a product designed to meet a specific need. It is engineered and built to satisfy in every detail the exacting demands of circulated water systems, *Silent, vibrationless operation* is the keynote of the Universal's performance.

Motors are specially constructed and selected for *extra-quietness!* Long *sleeve* bearings are used in both motor and pump and the oversized shaft is made of special alloy steel with an integral, heat treated thrust collar. Water leakage is prevented by the exclusive diamond-hard "Remite" mechanical seal. Flanges, bolts, nuts and gaskets for both suction and discharge sides and pet cocks for venting and gauge tappings are furnished without extra charge.

Send for descriptive literature and engineering data.



Easy to service...vertical split case construction permits removal of entire bearing frame without disconnecting pipes.

Reg. U.S. Pat. Off.

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"Open for Discussion"

• *WE FOLLOW HERE each month the practice at engineering society meetings of providing an "open for discussion" period. You are urged to take part. Just address your comments to the Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

Sheet Metal Duct Lining Doesn't Have to Be "Absurdly Expensive"

I HAVE read with interest Erwin L. Weber's comments ("Open For Discussion," September) on my article *Sheet Metal Ducts Are Solution to Critical Stack Effect Problem* (June). Evidently he and others have misunderstood my suggestion of sheet metal ducts in the pipe shafts.

I had no idea of lining the shaft with sheet metal which would be absurdly expensive. What I do refer to is a small sheet metal duct inside the pipe shafts with no pipes passing through it and no openings other than the inlets from kitchens and baths. Some pipe shafts are not wide enough for this. But if they are, room may be found for this metal duct without interfering with piping. The alternative is a separate masonry shaft. However, this seems to me more expensive and takes more room than my scheme.

I agree with Mr. Weber that draft conditions change constantly. But with adjustable dampers at the inlets a reasonable balance can be made for average conditions, perhaps after the building is occupied.

Yes, the trouble job I mentioned in connection with fried onions was a case not only of lax enforcement of fire laws, but also nonconformance with the specifications due to lax inspection by the architect or owner.

LEWIS SMITH
Heating Engineer
New York, N. Y.

"HPHW" Better Identifies System, As It Implies "High Pressure Boilers"

WE HAVE been following with interest the discussion on high temperature hot water and were impressed with the comments of E. G. Hansen (July) in which he suggested *high pressure hot water*.

The ASME code on low pressure heating boilers allows boilers to be constructed under the code provided the temperature does not exceed 250 F.

When a heating system is designed for temperatures above this, it becomes necessary to use boilers constructed under the power boiler code which in the trade are usually referred to as *high pressure boilers*. I therefore like the suggestion of *high pressure hot water* as it automatically indicates to the engineer, contractor, and others involved, that a high pressure boiler is required. This term tells a great deal about the system and boiler, and for the same reason we prefer the term *boiler* to *hot water generator* because, even though the water doesn't boil in a high pressure hot water system, the term is clearly understood to mean a unit that is direct fired.

M. T. WAY
Ray Burner Sales, Inc.
Long Island City, N.Y.

Fire Protection System, Fuel Valves Highlights of Jet Fuel Piping Job

THE ARTICLE by R. H. Schairer, *Jet Fuel Piping Delivers 1200 Gpm to Stratofort* (September), is both instructive and informative.

I am of the opinion that one of the most valuable phases of the subjects treated is that pertaining to the fire protection system. Without adequate fire protection, facilities such as those discussed in the article could be destroyed completely.

Another feature of the article is the arrangement and control of the fueling valves. The layout followed represents excellent planning and design and should be of much help to those who in the future may be called upon to prepare plans and specifications covering similar facilities.

The author is to be commended for a job well done.

C. T. BAKER
Consulting Engineer
Atlanta, Ga.

Install Water Feeder on Boiler To Keep Water at Lowest Safe Level

TOM E. KRIEG'S *How to Size Condensate Receivers for Gravity Return Systems* (June) is a worthwhile contribution because the use of undersized receivers may result in wasted fuel and in boiler scale due to overflow of hot condensate and, worse, may result in boiler corrosion due to introduction of unnecessary makeup water.

It would appear that a receiver is of adequate size when there is no overflow of condensate under any conditions of heating plant operation and when the burner or burners do not cut out due to low water at any period in the normal operating cycle.

It appears from a careful reading of the article that the author uses the term *makeup* to mean *feedwater* as well as to mean *makeup*. This dual usage of the term makes the article difficult to understand and could lead to incorrect conclusions.

Industry Standards — Engineering Information, 1954 edition, published by the American Boiler & Affiliated Industries, defines feedwater as "water introduced into a boiler during operation. It includes makeup and return condensate." The same authority defines makeup as "the water added to boiler feed to compensate for that lost through exhaust, blowdown, leakage, etc."

As an example of the author's dual usage, the second paragraph under "What Type of System Should Be Used?" on page 124 apparently refers to makeup since he describes the function of adding water to compensate for that lost due to evaporation, leaks, vent loss, etc. As a contrary example, the usage in Table 1 on page 126 apparently refers to feedwater since the amount of makeup in gallons per 10 minutes tabulated for any boiler corresponds closely with the total amount of water which would be evaporated by that boiler in 10 minutes.

In these comments, the terms *makeup* and *feedwater* will be used as defined by the American Boiler & Affiliated Industries.

In his analysis Mr. Krieg appears to disregard entirely the water storage capacity available in the boiler between the operating water line and the point of low water cutoff operation. There is no valid reason why the water line may not drop a considerable amount during the period of morning startup, and this water storage volume may be a substantial portion of the total evaporation that occurs between the time the boiler starts to steam and the time when condensate is being returned at normal rate.

For example, a steel heating boiler with a rated output of about 1 million Btu per hr has a water storage volume of approximately 35 gal between the normal operating water line and the point of low water cutoff operation. On the basis of the author's tabulation this boiler could operate more than 16 minutes before requiring any water from the receiver. Thus, the water available in the boiler is more than half the required capacity tabulated under "System time of 15 min." It would appear that a designer should not disregard the available water storage capacity in the boiler itself when sizing a receiver for a steam heating job.

The author has assumed that the water lost due to evaporation, leaks, vent loss, etc., should be replaced by a "feed valve installed in the receiver to maintain a minimum reserve." This would presumably be a float operated makeup valve. From the standpoint of the man who will pay for repairs due to boiler corrosion, this is not a desirable method of introducing the makeup water. It will maintain the water at the operating water line in the boiler or boilers even though large amounts of water may be lost from the system (such as the losses due to a leak in a buried return line) and the boiler operator will have no means of knowing that the water is being lost.

A better method is through the use of a water feeder on the boiler or on each boiler in a battery set to maintain the water at the lowest safe water line — not at the operating water line. With this system the operator uses a manual feed valve to maintain water at the operating level and he is warned of a leak if the boiler needs frequent manual filling.

Since the introduction of fresh water is one of the more common causes of boiler corrosion, the automatic water feeding device or devices should be set to protect each boiler by maintaining water at a safe level, and also to warn the operator in case of any considerable loss of water from the system.

The use of the author's method of computing the length of time after cold startup required until condensate is being returned at normal rate would appear to give results as accurate as may be expected due to the many variables which influence this length of time. It is believed that the actual size of the receiver may properly be adjusted to give credit for the amount of usable water storage in the boiler itself.

Automatic water feeding equipment should be installed in a manner which would warn the boiler operator in case of large concealed water leakage.

J. W. Turner
Engineering Consultant
Johnstown, Pa.

The Author's Reply—The closure of the article recognizes that, for proper evaluation, the engineer must know and understand the problem. In reading the comments by Mr. Turner, it is obvious that he has encountered this type of problem enough to be more than passingly aware of it. It is interesting to note that the complaint is made of dual usage when his own supplied definitions and the context of the article are in agreement.

Mr. Turner has missed the value of the third column in Table 1, labeled "Makeup, gal per 10 min." This amount was shown as a convenience to analysis by the author, and would be of use to engineers to save computation in sizing makeup valves, special studies of receivers, and general comparison of the method used by the author.

The next point raised by Mr. Turner is that the water storage capacity of the boiler was disregarded entirely. Referring to page 124 in the June issue, the last paragraph sets forth a rule: "Condensate return systems should be used until the calculated makeup added to the system will cause a storage rise not in excess of 2 in. in the normal water level of the boiler. If the makeup will cause the water level to rise more than 2 in., it is recommended that a boiler feed system be installed."

To examine the 1 million Btu per hr output boiler

(Continued on page 260)

Top heating performance by RECO atop the mile high city!

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Going up! This seven-ton RECO tank recently climbed 28 stories to a permanent spot on top of Denver's First National Bank Building. Now it is there to stay. This copper-lined hydropneumatic storage tank is typical of all RECO engineered products – including the copper-silicon generators, pressure tanks, and heaters which were installed at First National in less spectacular fashion.

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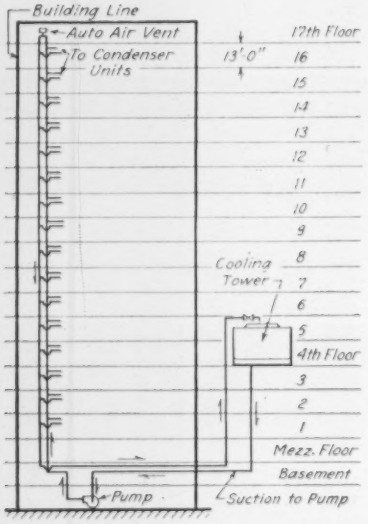
*Mechanical Engineers, Marshall & Johnson; Mechanical Contractors, Natkin & Company; Architects, Raymond Harry Ervin and Assoc.; Mead & Mount Construction Co.; RECO Representative, F. G. Downs Co., Denver

Question of the Month

What Is Correct Pump Head For Cooling Tower Piping?

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with answers that have been received from readers. Three answers to this question appeared in the October Question of the Month. Other comments for publication are invited.

"I have a problem of accurately determining the pump head for the piping system where cooling water is pumped from a sub-basement to condenser units on all of 16 stories and then to a cooling tower which has the water inlet on the fifth story level. See the drawing below.



I would appreciate any suggestions that others may have on how this problem may be solved."—J.A.W.

Height Differences, Friction Losses Determine Startup, Operating Heads

THE HEAD required when the system is running will be that due to the difference in elevation between the pump discharge into the cooling tower and the water level in the sump of the cooling tower, plus all of the friction losses in the longest piping circuit.

The head required to start the system up (give it an initial fill) will be the difference in elevation between the cooling tower sump and the automatic air vent, plus friction losses. This head could fall near the shut-off head of the pump, as reduced flow would probably be tolerable during filling. Once the system is filled the pump will operate as described above.

HAROLD BUMPUS
Engineer
D. M. Barnard, Consulting Engineer
Rochester, N.Y.

Find Net Static Head; Add Losses Through Pipe, Valves, Fittings, Coils

IF THE air vent is necessary to vent the system at its high point, then a positive pressure must be maintained at the vent.

If we assume that the vent is 2 ft above the 17th floor and that the tower drain pan water level is 2 ft above the fourth floor, then the net static head will be:

$$13 \text{ floors} \times 13 \text{ ft per floor} = 169 \text{ ft.}$$

If we assume that a 3 ft positive head is enough to insure venting at the high point, then the total static head is 172 ft.

Of course, to determine the total pump head, the dynamic losses should be added. These include the friction loss through pipe, valves, fittings, and condenser coils.

Although there is a pressure gain in the down riser which equals the pressure loss in the up riser, this gain cannot be used without causing a vacuum in the upper part of the system.

All WATTS Low Water Cut-Offs

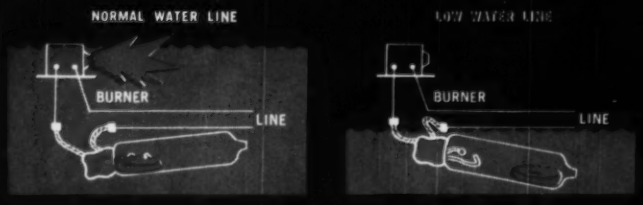
QUICK HOOKUP FITTING with copper tubing for easy, sturdy installation to gauge glass connections

HEAVY REINFORCED PURE COPPER FLOAT

FLOAT CHAMBER BOWL with large mud space — no ledges for mud accumulation

EXTERNAL DRAIN VALVE (¾") eliminates hazard of hand burns when flushing float chamber

feature foolproof Mercury Switches



CONTACT

NO CONTACT

Single throw mercury switch is designed to break the electrical circuit to the burner. The entire switch mechanism is simple, foolproof, and has no mechanical parts to wear, stick, or fuse together, unlike other designs. Excellent for gas-fired installations — see below.

It pays to play it safe . . . whenever you install low pressure steam boilers

You're completely protected when you specify Watts Low Water Cut-Offs for low pressure steam heating boilers. The Watts advanced-design features described above make them the most efficient, most dependable cut-offs available today. Their excellence is proved by their wide acceptance.

Watts offers a complete line of boiler water level controls for heating and process steam boilers. For complete information, including specifications and installation diagrams, send for Bulletin F-60.

Be on the safe side with

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Protection and Control Specialties

SELF-ENERGIZED CONTROL CIRCUITS ON GAS-FIRED HEATING INSTALLATIONS

The design of the standard mercury switch in all Watts Low Water Cut-Offs makes them **ideally suited** for millivolt service **on gas-fired heating installations.** Actual tests in use prove voltage loss is less than 1½ millivolts on a 700-millivolt circuit.

This means you need stock only one control for both standard and millivolt service.

Watts Regulator Company, Lawrence, Massachusetts

A slight vacuum would do nothing more than interfere with the proper operation of the air vent. If the water velocities were high enough, the air would be entrained and carried back to the tower where it would escape. The water would be lifted the last few feet by the siphon effect of the down riser.

The probable limit of the lift would be about 28 ft, due to air and water vapor which would be released from the water at low pressure.

Operating with a partial vacuum in the upper part of the system should be avoided because it greatly increases the rate of corrosion in the system.

W. J. McGINLEY
Engineer
Power Engineering Corp.
Wilkes-Barre, Pa.

Pump Head = Friction + Combined Static Head, Maximum Pressure Drop

I WOULD like to suggest the following procedure:

Total pump head = Pipe friction of system (pump discharge to tower inlet) plus combination of static head and condenser pressure drop that is a maximum.

Let:

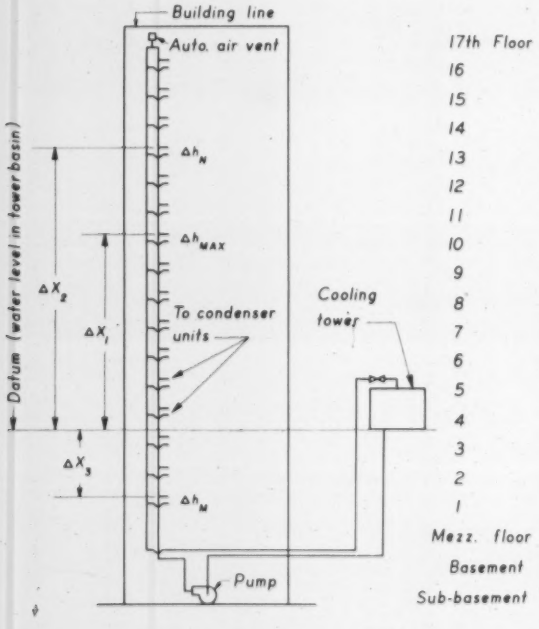
$\triangle h$ = total pump head required, ft
$\triangle h_1$ = pipe friction losses, ft
$\triangle h_2$ = loss due to combined static head and condenser pressure drop that is a maximum, ft.

Therefore:

$$\triangle h = \triangle h_1 + \triangle h_2 \quad \text{.....[1]}$$

The value of $\triangle h_1$ is readily available from the design engineer.

The value of $\triangle h_2$ is computed as follows (see the illustration below):



Let:

$\triangle h_{MAX}$ = loss through the condenser unit with the maximum pressure drop, ft
$\triangle h_N$ = loss through the condenser unit above datum with less than maximum pressure drop, ft
$\triangle h_M$ = loss through any condenser unit below datum with less than maximum pressure drop, ft
$\triangle X_1$ = static head required to condenser unit with h_{MAX}, ft
$\triangle X_2$ = static head required to any condenser with h_N above datum plane, ft
$\triangle X_3$ = static head required to any condenser unit h_M below datum plane, ft.

Since $(\triangle h_M - \triangle X_3)$ is obviously less than any value of $(\triangle h_{MAX} + \triangle X_1)$ it can be ignored.

Combined $\text{loss}_1 = (\triangle h_{MAX} + \triangle X_1)$ .....[2]
Combined $\text{loss}_2 = (\triangle h_N + \triangle X_2)$ .....[3]

Therefore:

$\triangle h_2$ = largest of two above combined loss values, ft.

Consequently, using Equation 1, the total pump head can be computed.

The cooling tower spray nozzle pressure drop is ignored here, but obviously must be added to $\triangle h$ for the total head required.

WILLIAM M. BUNTING
Mechanical Engineer
Strickland & Associates
Consulting Engineers
Birmingham, Ala.

READER ASKS —

"How Can We Protect Boilers' Internal Metal Surfaces?"

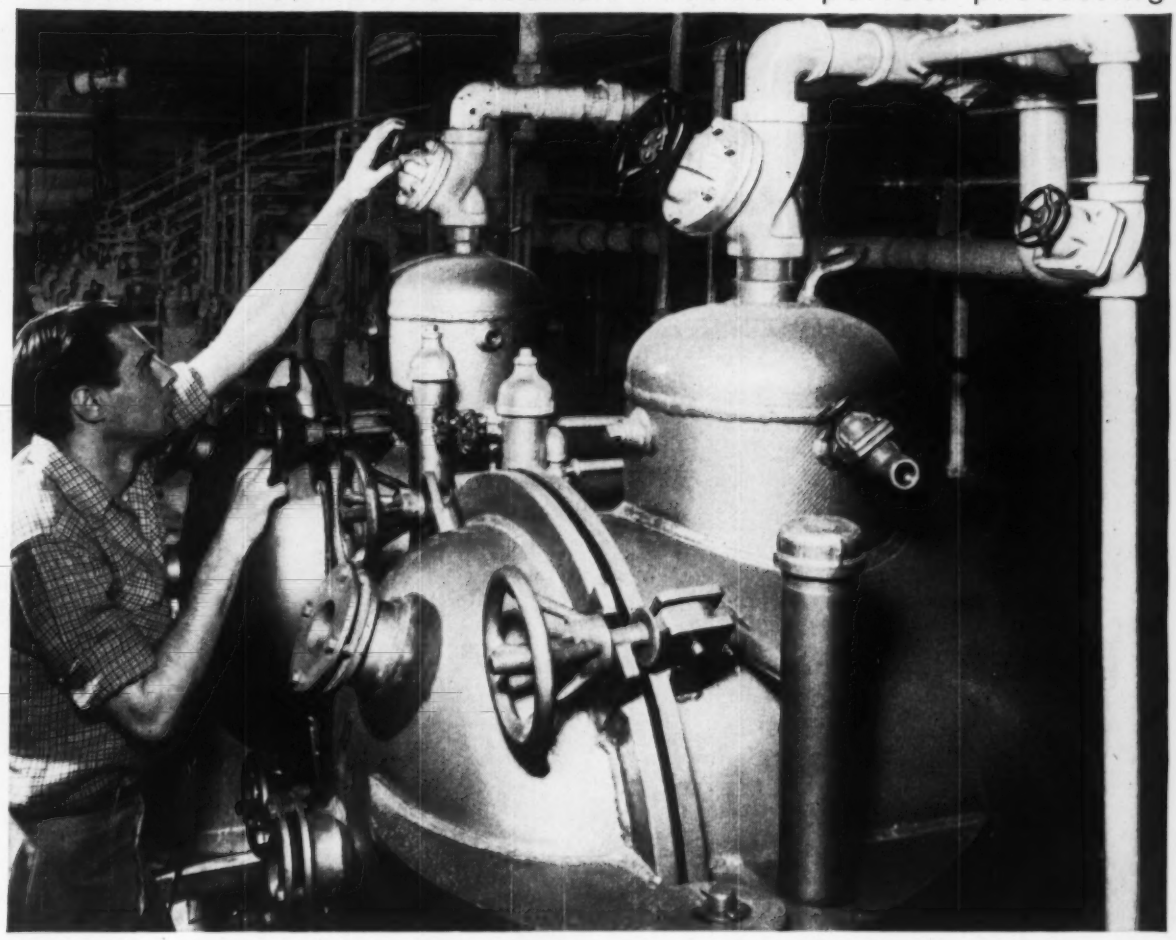
"A problem we have been encountering is the deterioration of the internal metal surfaces of our steam and hot water boilers, as well as some heat exchangers. This condition seems to get worse with higher temperatures.

"Are there any compounds or surface coatings available which retard or prevent this deterioration? If so, how are they applied? What are their compositions? What temperature and pressure limitations should be considered in their application?

"Any information others can offer will be greatly appreciated."—P.D.W.

• *YOU ARE INVITED to contribute a question for publication or an answer to a published question. Write: The Editors, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

Packless valves assure Electron Products perfect processing



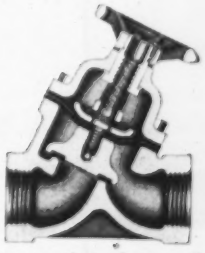
Crane diaphragm valves still hold tight after 18 months on 100-micron vacuum service

Electron Products Inc., Pasadena, Calif., forms special electronic parts of metalized paper. Processing—drying, deaerating, impregnating—is done under constant vacuum.

Valves, to hold the critical vacuum within a maximum leak rate of 100 microns for a 24-hour period during processing, had to be selected with care. Obviously not any valve would do. The choice—Crane diaphragm valves for high performance value.

After 18 months, these Crane packless valves continue to hold tight on this critical vacuum service for as long as 36 hours—and on occasion, over an entire weekend.

Crane packless diaphragm valves are widely used also in processing industries where absolute tightness is necessary to prevent leakage of volatile, corrosive and hard-to-hold fluids. Complete information is available from your Crane Representative. Or write for 24-page circular.



Cross section, Crane diaphragm valve—note diaphragm seals the bonnet only, separate from disc function. It is not subject to severe flexing, crushing and abrasion as in valves where diaphragm does both jobs.

CRANE VALVES & FITTINGS

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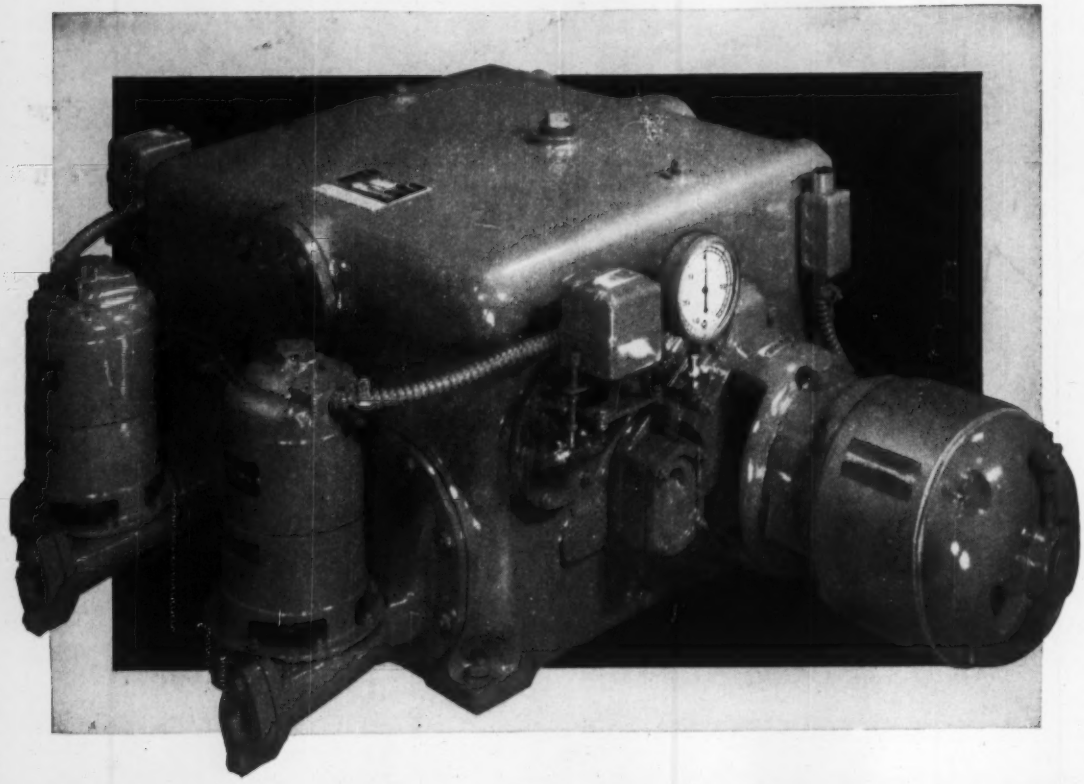
THIS NEW VACUUM HEATING PUMP IS SIZED TO ACTUAL JOB REQUIREMENTS



It's the Nash CSM

No longer is it necessary for the Engineer to accept a vacuum heating pump with air and water capacities based inflexibly upon square feet of equivalent direct radiation. With the flexible Nash CSM he can provide for proper air capacity in accordance with his judgment and experience. For the individual capacities of the separate pumps on the CSM may be varied within a wide range, without buying an oversize receiver and oversize water pumps.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low, returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY
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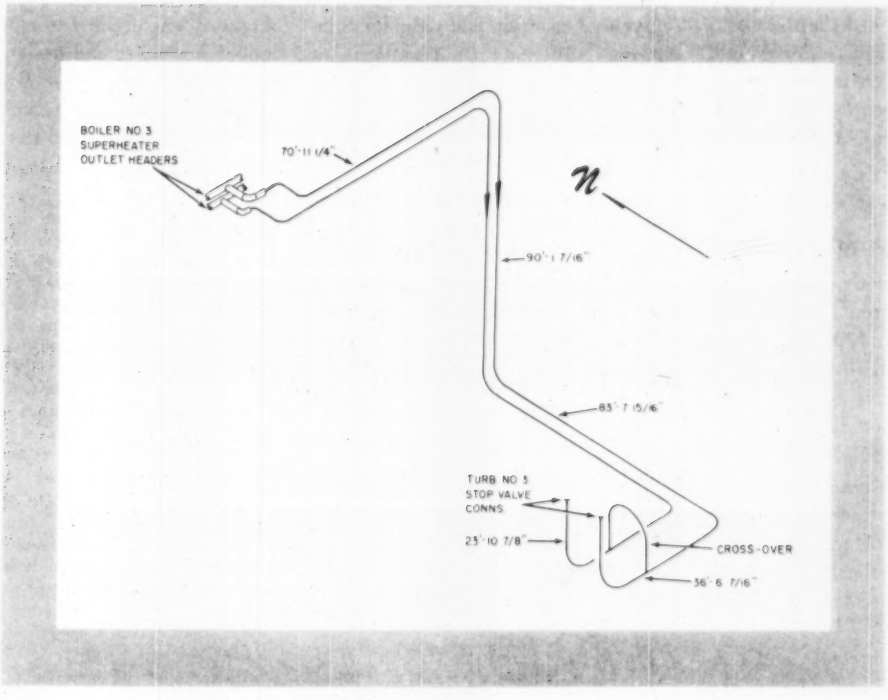
Many Factors Must Be Juggled To Arrive at Most Suitable

POWER PIPING DESIGN



Reliability was a particularly important consideration for Memphis' new electric power station, as the city previously bought TVA power and has no other generating facilities. Here's a complete explanation of the many factors that had to be considered by the consulting engineers to arrive at the best design for the 2625 psig, 1053 F main steam piping. The two-pipe system layout with a cross-over uses hollow forged chrome-moly pipe for straight runs, with turned-and-bored piping for bends

BY FRANK M. KAMARCK
Staff Mechanical Engineer
Burns and Roe, Inc.

THE COMMON GOALS of all power piping design are maximum efficiency, reliability, and simplicity — plus low cost initial installation, operation, and maintenance. The design of the power piping systems for the new Thos. H. Allen Electric Generating Station in Memphis — designed, engineered and currently being built by Burns & Roe, Inc. — has required special emphasis on immediate and continuing reliability. This special emphasis is necessary because Memphis has had no existing generating facilities of its own, either public or private. Previously all power has been purchased from TVA.

This new station will initially consist of $8 million worth of piping without valving. This piping will serve three 250,000 kw turbogenerating units. The first unit is scheduled to start operation by the end of this year and all three units will be operating early in 1959.

This emphasis on reliability, coupled with the high pressure and temperature of the plant and the large flows associated with the high rating, gave rise to some interesting problems in piping design.

A detailed description of one piping

system, rather than a general account of many, will better illustrate the type of engineering problems that arose and the development that went into the design of the piping systems for a plant of this size. Since the main steam piping presented the most critical problems in all phases of design, our discussion will center on this system. This main steam system is the most important and costly piping system in the plant.

Consider Many Design Factors

The sizing and design of the main steam piping required an evaluation of many factors and their complete inter-relationship. It involved:

1) *Determining the conditions that would set the maximum sustained design for the piping.* This would affect material selection and thickness of pipe wall. The considerations were:

a) Omission of the stop valve at the boiler superheater outlet, to place the piping under the Boiler Code

b) Maximum pressure and temperature the boiler can deliver, and their duration

c) Maximum pressure and temperature at which the turbine can operate, and their duration.

2) *Determining the conditions that would set the inside diameter of the piping,* such as:

a) Pressure drop available between the superheater outlet and the turbine stop valve

b) Maximum flow, on a volume basis, at the pressure and temperature that the boiler can deliver, and its duration

c) Maximum flow, on a volume basis, at the pressure and temperature at which the turbine can operate, and its duration.

3) *Determining the conditions that would affect the configuration or shape of the piping run from the boiler to the turbine,* including:

a) Allowable reactions at boiler and turbine piping connections

b) Movement of boiler and turbine piping connections

c) Physical relationship of boiler and turbine

d) Shortest physical path that overall plant layout would permit.

This would be the most ideal run of piping possible and, as such, would serve as a criterion and basis for comparing different combinations of diameter, thickness, flexibility, etc.

Design for 2625 Psig Steam

Based on an evaluation of the range of permissible operation of the steam generator and the turbine, the following steam conditions were selected as the basis for design of the main steam piping:

Maximum steam flow
= 2,050,000 lb per hr
Rated turbine throttle steam pressure
= 2400 psig
Maximum turbine throttle steam pressure
= 2500 psig
Steam temperature at turbine throttle
= 1050 F
Steam temperature at superheater outlet
= 1053 F

An economic evaluation considering the effect of pressure drop allowance for the main steam piping on the boiler design, equipment and material cost, and operation resulted in a design pressure drop of 80 psi.

Preliminary analysis indicated that savings would be realized by eliminating the boiler stop valve in the main steam line without prejudicing the reliability of the plant. (After the design had progressed, this conclusion was rechecked and verified.) Accordingly, it was decided to eliminate the boiler stop valve and design the main steam piping under the Boiler Code.

The pertinent paragraphs of the Boiler Code relating to the design of main steam piping are as follows:

Paragraph P-23 (a) states: "For boilers installed on the unit system (i.e., one boiler and one turbine or other prime mover) and provided with automatic combustion control equipment responsive to steam header pressure, the value of P for the steam piping shall be not less than the design throttle pressure plus 5 percent, or not less than 85 percent of the lowest pressure at which any drum safety valve is set to blow, whichever is greater, and the S value for the material used shall not exceed that permitted for the expected steam temperature at the superheater outlet."

Paragraph P-23 (f) allows increase of stress: "(1) Up to 15 percent above the S value during 10 percent of the operating period; (2) Up to 20 percent increase of the S value during 1 percent of the operating period."

Paragraph P-302 pertains to the rating required for the stop valves: "The nearest stop valve or valves to the superheater outlet shall have a pressure rating at least equal to the minimum set pressure of any safety valve on the superheater and at the expected superheated steam temperature; or at least equal to 85 percent of the lowest set pressure of any safety valve on the boiler drum at the expected steam tem-

Here's Overall Description of Power Station

The overall arrangement of the Thos. H. Allen Electric Generating Station is designed on a unit steam generator-turbine basis, with the exception of certain common service systems such as coal handling, circulating water, compressed air, and ash handling.

The steam generator is of the natural circulation type and utilizes cyclone burners. It can fire coal and gas together or alternately. The turbine cycle consists of an eight-stage regenerative feedwater heating system with four high pressure feedwater heaters, a deaerating heater, and three direct contact low pressure heaters.

The steam generator supplies steam to the turbine at 2400 psig, 1050 F with a single reheat to 1050 F. The piping is designed with provisions for operating the turbine at a throttle pressure of 2625 psig in order to obtain additional plant kw capability.

perature of the superheater outlet, whichever is greater."

From these, the sustained design pressure for the piping was determined to be:

2500 × 1.05 = 2625 psig, based on throttle pressure
2825 × 0.85 = 2401 psig, based on lowest drum safety valve pressure.

Therefore, 2625 psig was set as the sustained design pressure for the main steam piping.

Design Temperature Is 1053 F

Regarding selection of the sustained design temperature, the temperature of the steam to be delivered at the turbine was 1050 F. To allow for about a 3 F deg drop in the piping due to pressure drop and heat loss, the boiler superheater had to deliver 1053 F at the outlet. In addition, the expected range of steam temperature fluctuation under automatic control was ± 10 F deg. The swing toward the plus side had to be considered in determining the design temperature, together with its probable duration.

It was decided that although wide excursions of temperature might be expected during startup, the swings would be minimized or eliminated at full boiler pressure under steady generating load.

If the allowable stress were selected strictly to the Code minimum for 1053 F, the stress for the chrome-moly material under consideration at the ± 10 F deg swing (or 1063 F) would exceed the Code allowable stress for that temperature by 7.4 percent. If an extrapolation of the Code allowance overstress *vs* time were used, this overstress might permit operation of piping designed in accordance with the Code's allowable stress for 1053 F at a temperature of 1063 F about 40 percent of the time.

Provide Added Safety Margin

It was decided that 1053 F would be used as the sustained design temperature in determining the minimum Code wall thickness, and that the selection of a higher commercially available thickness would provide an additional safety margin. In the final piping design a sufficient margin above the Code minimum wall thickness resulted from the selection of the nearest heavier wall manufactured by the hollow-forge process, and in the allowance for bending and scaling in piping used for bends manufactured by the turned-and-bored process. In addition, the manufacturer's tolerance was not fully utilized during the manufacture of the piping, adding a further margin above the code minimum wall thickness.

ID Size Based on Flow, Volume

The maximum volume to produce the highest pressure drop condition in the steam piping would be the maximum product of the flow, in pounds per hour, and the specific volume. The difference in viscosity of the steam, where pressure-temperature conditions are grouped closely together, would be too small to influence the selection of the maximum pressure drop conditions.

The conditions that set the internal diameter of the piping were the maximum flow of 2,050,000 lb per hr and the specific volume of 3331 cu ft per lb at 2440 psig average at 1063 F, with a pressure drop of 30 psi.

After examining the plant layout, the shortest and most feasible path for the main steam piping was selected. This selection determined some of the criteria for the final design.

Shortest Path Not Always Best

The best path is not necessarily the straight line between the steam generator and turbine connections. It is the studied path that takes into account all of the physical features for a good final overall plant design.

For pressure drop purposes, the length of this shortest usable run was established at approximately 300 ft. An allowance for bends and for the drop through the flow nozzle was made. With that as a basis, it was found that a pipe with 12½ in. ID would produce a 75 psi drop with a steam velocity of 13,200 fpm, at design conditions. This would have been satisfactory if the questions of wall thickness and piping flexibility were not involved.

Past experience indicated that the path selected would probably not provide sufficient flexibility necessary to meet the allowable reactions at boiler and turbine connections. If this turned out to be so, the increased run might raise the pressure drop over the planned 30 psi. This, in turn, would necessitate a larger internal diameter to bring it back within the limit.

Material Selection Based on 1053 F Design Temperature

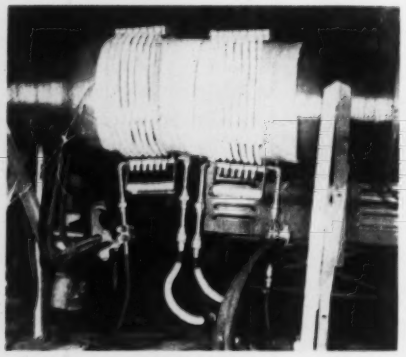
Before wall thickness could be calculated, the material to be used had to be selected. The main criterion here was the design temperature of 1053 F previously selected.

This design temperature would still allow the use of a chrome-moly alloy without excessive scaling. The chrome-moly alloys are considered the standard high temperature materials in the modern power plant installation, and their fabrication, welding and performance have been thoroughly proven. But the use of an austenitic stainless steel was tempting because of the much higher allowable stress in the elevated temperature range which would result in thinner walled and more flexible piping.

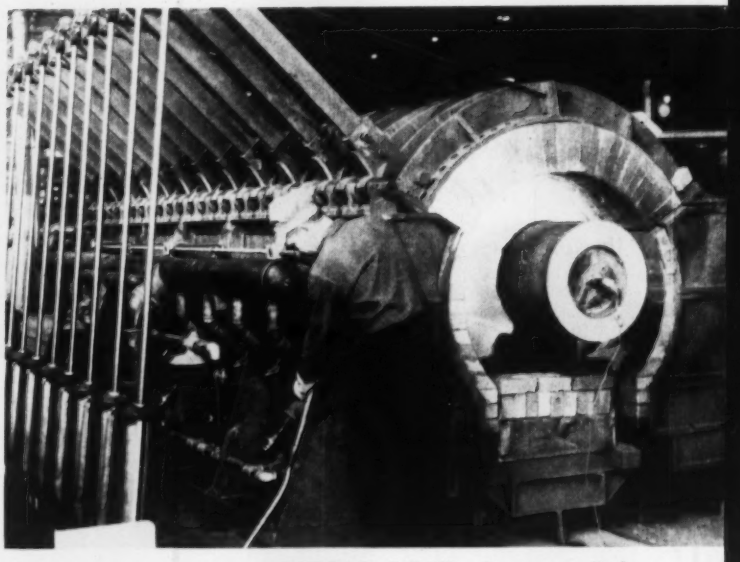
However, at the time of this design

(Continued on page 100)

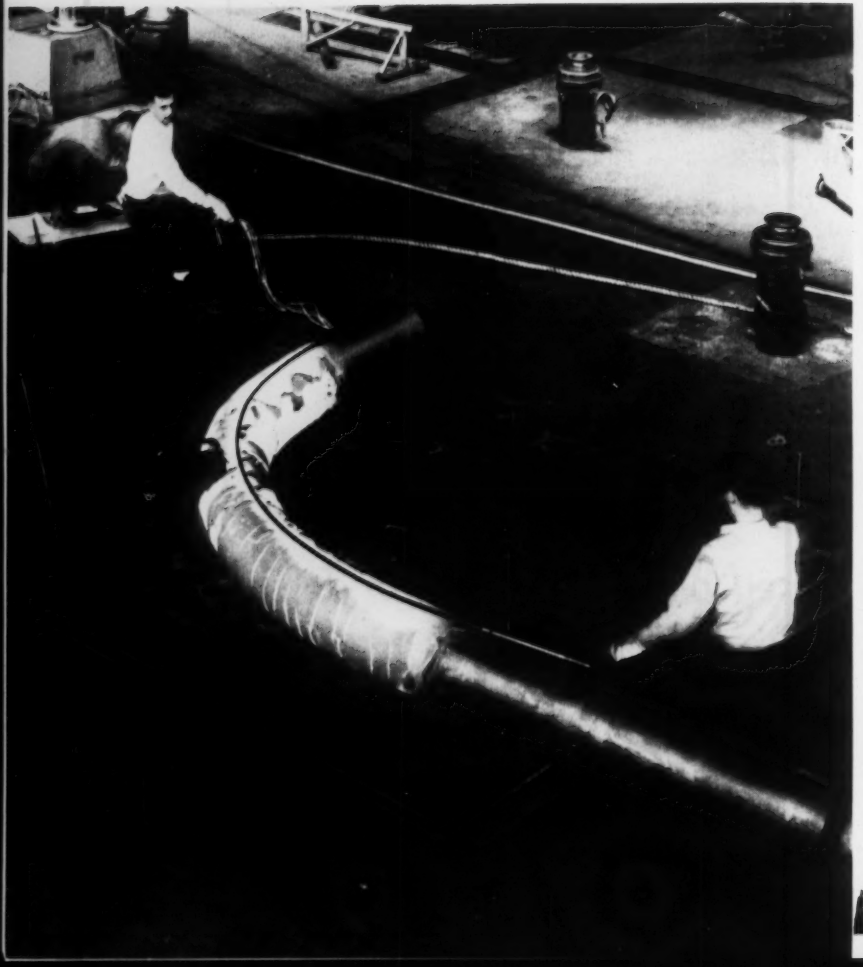
Six Steps to Fabricating Memphis' Power Piping . . .



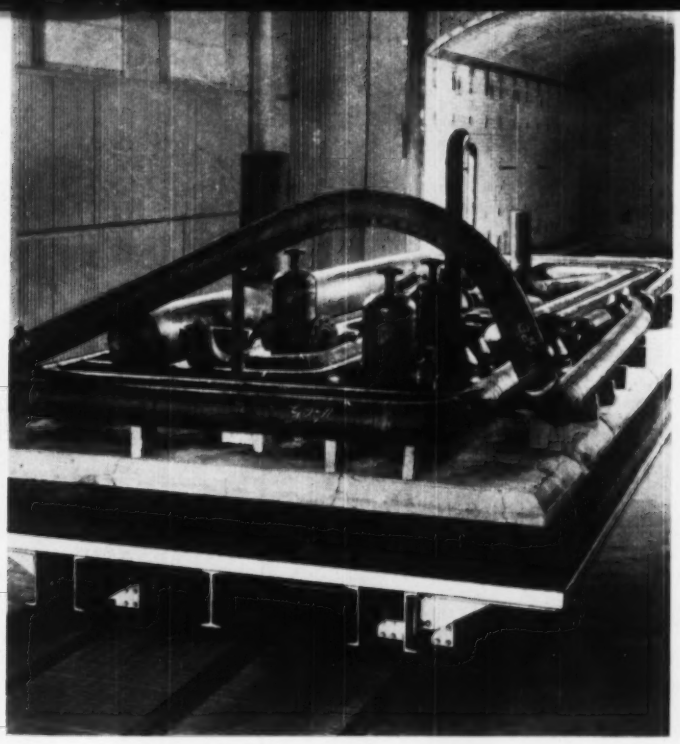
1 SNAP-ON water cooled coils pre-heated and stress relieved welds in the field by electric induction



2 GAS FIRED close-controlled temperature furnace was used for heating heavy walled alloy and carbon steel pipe for bending. Note asbestos blanket for protection against direct flame impingement. Pipe is packed with sand, ends plugged. Internal temperature is measured with pyrometer

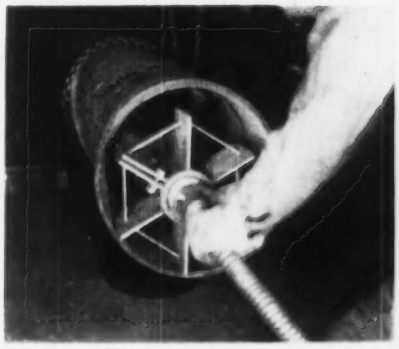


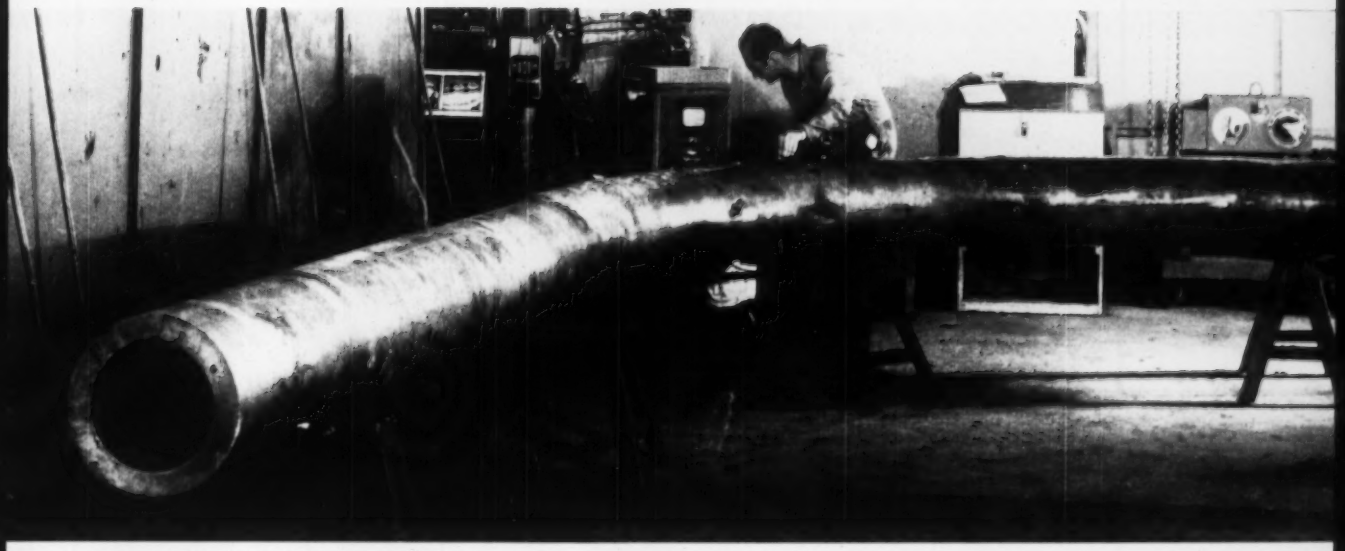
3 PIPING was bent on bending table. Shoes and pins hold pipe in place



4 VIA RAILCARS, piping was moved into gas fired, thermostatically controlled annealing furnace for full furnace stress relief and heat treatment

5 AFTER HEATING operations, scale was removed from pipe through use of air turbine driven centrifugal rotary cleaner





6 ULTRASONIC TESTING of thickness of pipe walls after bending was accomplished using audigage

(Continued from page 97)

(and to a certain extent at present) there were unresolved problems in the fabrication and performance of austenitic stainless steel. These relate principally to the best choice of a stainless alloy, welding to a ferritic alloy at boiler or turbine connections, and the development of cracks in some installations. Also, at that time, pure Columbium stabilized material was unavailable and delivery of stainless steel piping was unreliable and usually delayed due to the nickel priority situation.

In setting the basic approach to the design of this plant, it had been decided that the most reliable methods and materials proven sound in actual operation practice would be followed throughout. Accordingly, it was decided to use a chrome-moly alloy—2¼ percent Cr-1 percent Mo alloy ASTM A335-P22—since it had the highest allowable stress value at the design temperature, and the greatest accumulated record of experience.

Choosing Wall Thickness Was Perplexing Problem

Using the Code equation for minimum wall thickness and allowing for undercut finish at weld ends, it was found that the nearest suitable hollow forge wall minimum thickness available for 12½ in. ID was 3⅞ in. for the straight runs and 4 in. for bends.

This range of thickness was an unpleasant fact to be faced. As far as could be determined, only the Joppa Steam Electric Station had a wall thickness in this range at the time, and it had been on the line only about two years.

In addition, there was the problem of possible cracking because of too rapid heating or cooling of walls of this thickness. Such cases had occurred in heavy walled cylinders other than piping. Heating would produce high compression stresses and cooling would produce high tensile stresses which, combined with stresses caused by internal pressure and thermal expansion, might prove disastrous.

The time element for bringing the turbine unit on the line and the possibility of some mishap throwing the unit off the line had to be carefully considered.

Holding this aspect of thickness in abeyance, the question of meeting the allowable reactions at the boiler and turbine connections with this thickness was next investigated by means of a stress analysis.

Analysis Shows High Flexibility

The importance of the allowable reactions at the turbine and boiler in the design of the main steam piping may be seen from the results of the final design. Stress results showed the final design of the main steam piping to be extremely flexible. The maximum stress for the final pipe design was 5925 psi, only a fraction of the allowable code stress of 20,200 psi. Yet, the final reactions at the turbine connections were barely within the allowance of the turbine manufacturer.

An examination of the conditions governing the flexibility of the piping showed the following:

> Allowable code stress for material ASTM A335-P22 at 1053 F = 20,200 psi
>
> Allowable reactions at turbine = 1.5 million in.-lb resultant moment at each turbine connection
>
> Resultant force at each turbine connection = 15,000 lb.

These reactions were not as liberal as they appeared. They were "range reactions" based on the cold modulus of the material, and not reactions in either the hot or cold conditions. These were the allowable reactions between the line-up of the turbine when cold, to operation when hot. The "reaction" credit for cold spring of the piping could not be taken since we were dealing with an allowable reaction range.

Allowable reactions at the boiler connections were to be "reasonable." The boiler specification called for the outlet headers to be designed so as to take the thrusts and bending moments normally encountered in the piping systems.

In order to perform the stress analysis, the expected movements at the boiler and turbine connections were obtained from the manufacturers. A preliminary short cut stress analysis was run off for the main steam line to obtain the probable range of reactions. The results were not encouraging. The resultant moment at each turbine connection was in the range of 3 million to 4 million in.-lb, more than double the allowable resultant reaction.

It was obvious that the large internal diameter combined with the heavy wall created a rigid pipe with the high moment of inertia of 7056 $in.^4$, and that this required a much more circuitous route to obtain the flexibility needed to absorb the thermal expansion within the allowable end reaction. A re-examination of the route between the boiler connection and turbine showed a possibility of substantially increasing the flexibility by doubling back on two of the horizontal legs and increasing the total length of run by about 100 ft. A new short-form stress calculation showed that the reactions should be in the allowable range with this increased run.

Pressure Drop Another Snag

The pressure drop for this lengthened run, however, was now over the allowable limit. This opened up further unpleasant prospects. The internal diameter would have to be made larger to reduce the pressure drop. As a byproduct, the larger internal diameter would necessitate a still

heavier wall thickness. This in turn would increase the moment of inertia of the pipe and require still greater flexibility to meet the allowable reactions at the turbine connections and could necessitate a further increase in the length of the piping run.

Check Multiple Piping Runs

It was decided at this point to hold off further design on this single pipe and investigate the possibility of a multiple run of piping from the boiler to the turbine.

The first alternate design considered was that of using two pipes from the boiler to the turbine. Since there were two boiler connections and two turbine connections, this was an appealing design. A cross-over between the two pipes would be necessary in the immediate vicinity of the turbine for the purpose of testing the turbine stop valves while operating and maintaining a continuous flow through the superheater headers. The internal arrangement of the superheater provided for the equalization of steam temperature in the two superheater outlet headers by alternation of the tube elements.

The same procedure was followed as that used for the single pipe, except that the maximum flow for each pipe was one-half of the total, or 1,025,000 lb of steam per hr. An ID of 9¾ in. was found to give a pressure drop of 70 psi, with 10,930 fpm velocity for the pipe run between the boiler and the turbine. This provided a differential of 10 psi as a margin against changes in design of the piping as the layout developed in detail. The next smaller ID available, 9½ in., gave 79 psi pressure drop and a higher velocity. This was too close to the limit allowed at this early stage of the design.

The 9¾ in. ID gave a minimum thickness of 3 in. and a moment of inertia of 2979 in.⁴. With this as a basis and using the minimum feasible pipe run between the boiler and the turbine, a short-form stress analysis indicated that the resultant reaction at the turbine connections should be satisfactory.

This two-pipe design showed several desirable features:

The thickness of the pipe wall was substantially reduced and brought into the range of other power plant installations. The pressure drop was below that allowed, and even promised a favorable margin. The pipe run could be kept within the minimum feasible path established earlier.

But What About Cost?

The major question now was one of comparative cost. It is fairly difficult, in the early stages of design, to run a cost estimate with any degree of accuracy. We had, however, established the necessary data for a workable two-pipe system, and had made a fair approach toward establishing the requirements for a single-pipe system.

Our estimate showed that the cost of the one-pipe system for three units would be $1,450,000. For the two-pipe system we estimated $1,150,000. These costs covered the completely erected system, with hangers and insulation. The cost difference resulted from the fact that the two-pipe system could follow the shorter path, and the price differential climbed sharply for the heavier wall single pipe in manufacture, fabrication, and welding.

This clear-cut estimated difference definitely tipped the scales in favor of the two-pipe system.

Are More Pipes Better Yet?

The possibility now had to be considered that perhaps three, four, or even more pipes might prove to be more economical. An examination of the layout of the station and the minimum feasible path revealed that physical limitations precluded the use of anything beyond a three-pipe system without major changes in the station design.

The same approach used on the one-pipe and two-pipe designs was followed in studying the three-pipe layout. The results were a 7¾ in. ID pipe with a 2⅜ in. minimum wall, and a moment of inertia of 1201 in.⁴.

The estimated cost of the three-pipe system was higher than the two-pipe system and about as high as the one-pipe system.

Compare Prices

A comparison of prices indicated that the difference in price per foot of manufactured pipe between the two-pipe and three-pipe size was $40 per ft. The difference between the two-pipe and one-pipe size was $170. per ft. Fabrication, welding, and erection showed similar closeness for the two-pipe and three-pipe systems. In addition, no advantage could be gained from the higher flexibility of the three-pipe system since no shorter feasible path could be followed than that used with the two-pipe system.

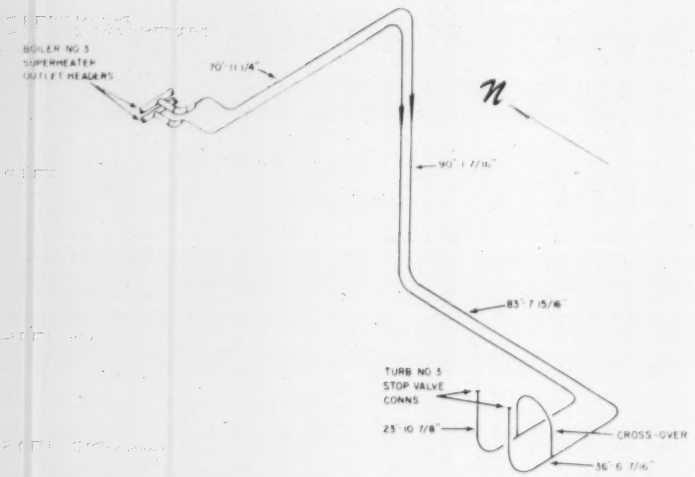
A clear-cut decision could now be made in favor of the two-pipe system.

The only remaining problem was the sizing of the cross-over between the two pipes. Although the possibility existed of making the cross-over smaller, it was decided to use the same size as the main runs for the sake of simplicity.

It was not possible to estimate accurately the effect of the cross-over restraint on the flexibility of the two pipes without a complete formal stress analysis. The run-off of the stress analysis on the electronic computer revealed that the resultant moment at the turbine connection was 2,130,000 in.-lb, as compared to 1,500,000 in.-lb allowed by the turbine manufacturer. It therefore became necessary to increase the flexibility of the system.

Investigation of the flow requirements for the cross-over revealed that a flow of 875,000 lb per hr with 33 psi pressure drop in the cross-over would satisfy the requirements of the boiler manufacturer on flow through the superheater headers and enable testing of either one of the turbine stop valves while operating.

Specification Data for Memphis Plant's Main Piping Systems

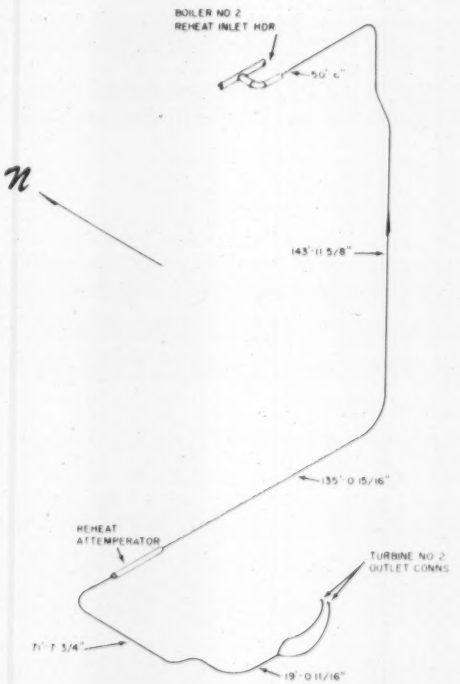


MAIN STEAM PIPING

Maximum sustained conditions for design: 2625 psig at 1053 F.

Material: Chrome-Moly ASTM A335-P22 for straight; ASTM A369-FP22 for bends.

Schedule: Straight pieces 16¼ in. OD × 9¾ in. ID × 3 in. minimum thickness; bends 15⅞ in. OD × 9¾ in. ID × 3-1/16 in. minimum wall thickness.



LOW TEMPERATURE REHEAT PIPING

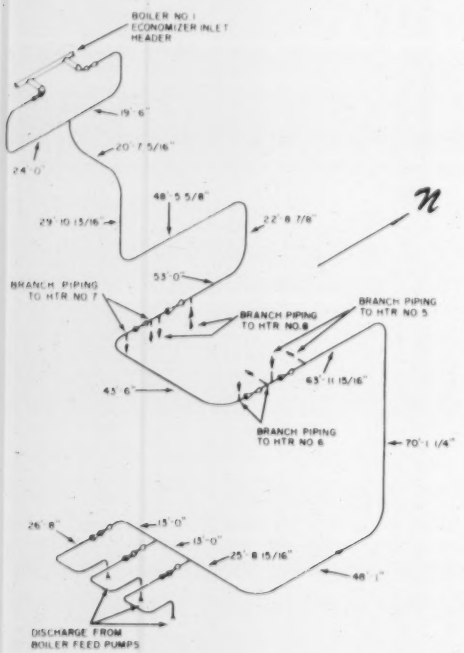
Maximum sustained conditions for design: 670 psig at 730 F.

Material and schedule: Rolled and welded plate manufactured to ASTM A155.

Class 1 with material to conform to ASTM A212 Grade B.

Wall thickness: 0.718 in.

(NOTE: Seamless pipe was not available for size required and delivery was of paramount importance.)



BOILER FEED PIPING

Maximum sustained conditions for design:

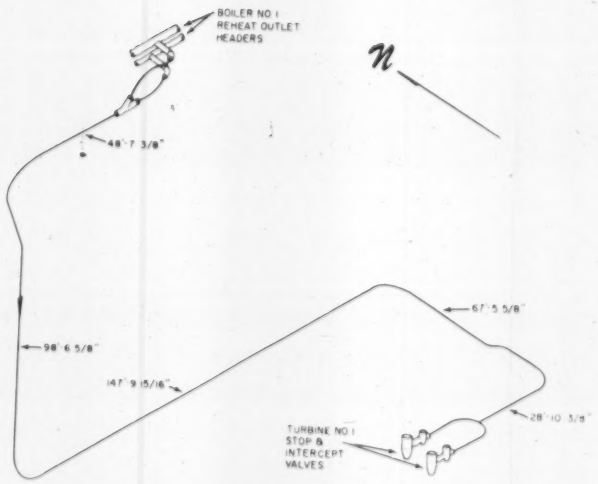
3075 psig at 60 F

2840 psig at 540 F

Material: Carbon steel ASTM A106 Grade C.

Schedule: Main run: straight 16 in. OD × 1 7/16 in. minimum thickness × 12¾ in. nominal ID; bends 16¼ in. OD × 1 9/16 in. minimum thickness × 12¾ in. nominal ID.

Branches: straight and bends 12¾ in. OD × 1¼ in. minimum wall thickness × 10 in. nominal ID.



HIGH TEMPERATURE REHEAT PIPING

Maximum sustained conditions for design: 630 psig at 1053 F.

Material: Chrome-Moly ASTM A335-P22.

Schedule: Main run: Straight pieces 24 in. OD Schedule 100; bends 24 in. OD Schedule 120.

Branches: Straight and bends 20 in. OD Schedule 120.

The additional flexibility was then obtained by carefully sizing the diameter of the cross-over for this flow without any dimensional changes in the layout of the cross-over or the main piping leads. This gave a cross-over size of 7¼ in. ID with 2-5/16 in. minimum wall and moment of inertia of 841 in.⁴. A re-run on the electronic computer indicated that the allowable reactions at the turbine had been met.

The basic design of the main steam piping was now complete and the problems of fabrication and erection could be considered.

Favor Bending Pipe Elbows

On piping with thickness above the standard pipe schedule, such as the main steam and boiler feed discharge, five diameter bends were used since bends proved to be more economical than forged elbows. Cast elbows were considered but not used due to limited experience at that time in the power field, and to a number of questions that had not been resolved by the Code committee involving wall thickness design requirements and quality control on inspection.

An allowance was made for thinning of the pipe wall on bends and for heat treatment scaling in specifying pipe wall thickness in accordance with the Code. The allowable stresses and minimum wall thicknesses called for in the Code are intended to determine the final fabricated piping system. The practice of the fabricator in this respect was to take the Code minimum thickness and divide it by 0.93 to obtain the minimum wall thickness necessary for a five diameter bend.

Since there was an appreciable amount of straight piping that did not require a fabrication allowance, the thinner wall thickness was specified in order to achieve the cost saving.

The piping contractor was required to set up an acceptable procedure to check the thickness of pipe wall after the bending operation and to submit a record of the resulting thickness to the engineers. This requirement insured that the Code minimum wall thickness would be achieved for every fabricated bend.

Cost Evaluation, Fabrication, Cold Spring Affected Selection

With the cost of turned-and-bored piping being $295 per ft as compared to $185 per ft for hollow forged piping, a careful economic evaluation of the entire fabrication and erection procedure for the main steam piping revealed that it was advantageous to use the latter for straight runs, and turned-and-bored for the bends.

The decision to select turned-and-bored piping for the bends was also influenced by the shorter delivery from the manufacturer. This piping could be delivered to the shop earlier for fabricating the bends. In addition, longer pieces could be fabricated for shipment to make better use of the maximum shipping sizes allowed, thus eliminating the need for a circumferential weld in the bend sections.

In the final analysis, a number of advantages and an overall economic saving resulted from the use of turned-and-bored piping for bends, and hollow forged pipe for straight runs. These included an improved fabrication schedule, due to earlier delivery of turned-and-bored pieces; better utilization of maximum shipping sizes; less field weld joints and less joints in the final piping systems; and less ASTM tests required due to numerical reduction of pipe pieces.

The hollow forgings were bought in cut lengths, although a premium had to be paid for this specified requirement. Nonetheless, this procedure was more economical than buying random lengths, where a charge for over-run of 10 percent was possible with no control of lengths of pipe pieces.

Shop Welds Cut Costs

The use of cut lengths, plus the longer pipe sections made possible by the turned-and-bored process for the bends, enabled a better fabrication layout for the shop with a consequent saving in both fabrication and welding. When random piping is bought the fabricator cannot detail the piping until it is delivered. With cut lengths, however, the piping can be detailed as soon as the piping arrangement layout is completed, and the shop can begin fabrication on the day the pipe lengths are delivered.

It was important to do as much shop welding and as little field welding as possible in order to increase the reliability and to minimize the cost. Shop welds are made under carefully controlled conditions, and the estimated cost per weld was about $2000 as compared to about $3000 for each field weld.

Decide to Cold Spring

The decision concerning cold spring was to cut the pipe short and cold pull 100 percent of the expected thermal expansion. The primary objective was to eliminate most of the end reactions from the connected equipment under the operating conditions. With this approach, the effects of thermal expansion would be transferred to the piping and equipment in the cold condition when allowable stresses are highest.

Para. 620 (c) of the Code for Pressure piping states:

"In order to modify the effect of expansion and contraction, runs of pipe may be cold sprung. Cold spring may be taken into account in the calculation of the re-

actions. . . . provided an effective method of obtaining the designed cold spring is specified and used."

To insure the proper cold springing, the piping contractor was required to submit for the approval of the engineers the complete procedure and method to be used for cold springing of all critical lines such as main steam, hot and cold reheat, boiler feed discharge, and bleed steam piping to high pressure heaters. This submission included copies of calculations establishing the magnitude and location of the single forces and force couples necessary to assure that the correct rotations and deflections were obtained at the final closing joint in bringing the ends into alignment. These loadings were maintained while the final joint was welded and post heat-treated. A dynamometer was used to measure the forces applied in the cold springing of the main steam piping.

The procedure specified in detail each step to be followed in the field. These included the sequence of erection of the piping; erection of hangers; placement and removal of travel stops in the hangers; the location of attachments for all pulling tackle to the building structure and attachment to piping; the use of safety rods to protect piping in event of pulling tackle failure; the sequence of application of forces with their magnitudes; and the sequence of release of pulling forces after heat treatment of final closure weld to avoid sudden unloading.

The final weld in each case was selected at the point where the torsional and bending moments were at or close to the minimum moments in the system. This minimized the rotational misalignment.

The building structural steel was checked to make sure it was strong enough to sustain the forces imposed by the pulling tackle.

Isometrics Speed Pipe Hanging

Isometric drawings were required from the hanger contractor for each piping system containing 2½ in. piping and larger, and for all smaller sizes of spring supported lines. The information shown on these isometrics included dimensioned location of all hangers with all pertinent data such as type, size of hangers, cross-reference to details for each hanger, calculated weight carried by each hanger and equipment connection, calculated movement at each hanger, movement of equipment and any other information necessary to evaluate the adequacy of the pipe hanging system. In addition, the hanger vendor submitted to the engineers copies of all design calculations upon which the design and selection of hangers, anchors, guides, supplementary steel, etc., were based, including all weight and movement calculations.

These provisions in the piping specification assured an adequate hanging system because the calculations and the isometrics facilitated the checking of the hanging system design in the shortest engineering time. The isometrics provided the necessary key to the mass of details involved in the design of the hanging systems for piping. The isometrics were also useful to the inspector in the field for checking hangers.

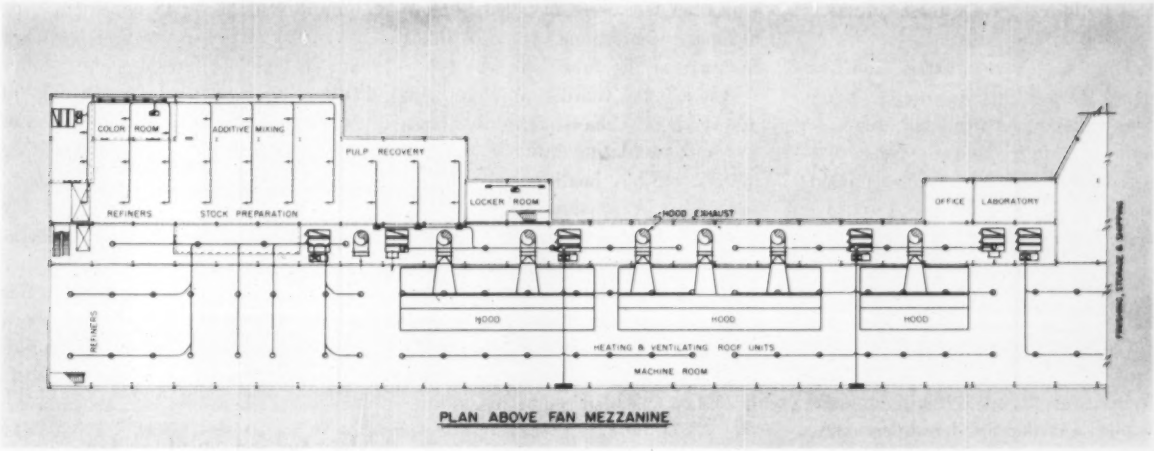
Constant support hangers that allow movement without loading change were required for piping subject to vertical movement in excess of ½ in. (for example main steam, hot and cold reheat systems, bleed steam to the higher pressure heaters, boiler feed discharge system). Constant support hangers were also required at locations where it was necessary to avoid any transfer of piping loads from support to support or onto critical terminals or connecting equipment.

Determine Hanger Locations

Since the piping would impose heavy concentrated loads on the building structure, preliminary calculations were made on the main steam, hot and cold reheat and boiler feed discharge piping systems to determine the location of hangers and weight to be carried. These loads were considered in the building structure design. Additional steel framing and heavier beams were especially provided in the area in front of the turbine where much of the heavy piping merged for connection to the turbine. The remaining piping loads were taken care of by including a live piping load allowance of 15 to 40 psi, depending on the floor location.

One rigid hanger was used on the riser of each hot piping system to act as a check point against possible sagging of the piping in time due to various causes such as piping creep and unbalance in loading of hangers. From the stress calculations for each case, the location of this rigid hanger was carefully established at the neutral point of no-vertical-movement so that the natural flexibility and end reactions of the pipe line would not be impeded.

There were many more design details that had to be evaluated such as selection of the ASTM supplementary tests to be applied to the piping, design of weld joints, welding procedure, preheat and stress relief procedures and extent and type of weld examination in the shop and in the field, etc. ∓



NEW PAPER MILL, shown above in plan view, houses pulp preparation equipment at left, paper machine proper in narrow central section. Machine can turn out 230 tons of paper per day. Almost two tons of water evaporated in drying must be exhausted for each ton of paper produced. Spot cooling is necessary for workers—even in winter

Quality Book Paper Manufacture Needs *Quality* Ventilation, Heating

Fine book paper must be produced in an atmosphere where the humidity does not exceed reasonable limits, lest moisture — or lack of it — have an adverse effect on product quality. This installation shows how well integrated industrial humidity control, heating, and ventilation systems can be designed to meet this requirement.

BY G. P. PATTERSON
J. E. Sirrine Co.
Consulting Engineers

THE P. H. Glatfelter Co., Spring Grove, Pa., has recently placed into operation a new paper manufacturing machine for the production of fine book papers—and along with it the necessary systems for ventilating and heating the new building in which it is installed.

The machine has a maximum production of 230 tons of paper per 24 hr at a speed of 2000 fpm. It is of the Fourdrinier type with a wire 188 in. wide, a press section, 60 paper dryers divided into three sections, two calender stacks, reel, winder, and finishing equipment.

The new building houses, at its west end, the pulp preparation equipment. The paper machine proper occupies the narrow central section of the building. Finishing, storage space, and shipping facilities are in a multi-story building adjoining the machine room on the east.

The high roof section, which continues into the finishing area, is 629 ft long × 72 ft wide × 65 ft high from ground to roof, including an above ground basement 19 ft high. Including its high roof section, the refining area is 125 ft wide, with full basement. The finishing, storage, and shipping building is irregular in shape and is three stories high. The

new buildings have a total volume of about 4 million cu ft.

They are of steel frame construction with reinforced concrete floors. The walls are an insulated aluminum sandwich, fabricated in place, with corrugated aluminum sheets inside and out. The insulation is 1 in., 6 lb density glass fiber.

Combat Moisture Condensation

Care was taken to prevent moisture condensation within the sandwich. Two 48 in. high tinted plastic bands, installed in double thickness, run the full perimeter of the building. One band is 4 ft above the floor, the other is near the eaves. The roof deck is made of precast concrete channel slabs with 2 in. of vegetable cork insulation under its weatherproofing.

The paper machine hood is divided into three sections, with one hood over each dryer section, to permit removal of the breaker stack and size press rolls. The hood is fabricated of corrugated aluminum sheets with a continuous exhaust plenum at the ridge.

Choose Aluminum Components

Exhaust stacks, ventilation equipment casings, intake louvers and screens, and all ductwork are fabricated of aluminum sheets with aluminum angles for bracing and hangers. Air outlets are of aluminum, also. Aluminum was selected because of its long life and also for esthetic reasons.

Except for a few units that are necessarily located in the basement, the ventilation equipment is located on mezzanines or platforms provided for that purpose. With the exception of two in the storage area, all units are field assembled.

Itemize Ventilation Equipment

The air supply units consist of screened air intake louvers, insulated intake ducts, automatic air filters, steam heating coils with face and bypass dampers, and casings. Most of the fans are centrifugal, but a few vaneaxial fans were installed because of space limitations. Hood exhaust fans are of the tubeaxial type.

Among the ventilation equipment are six hood exhaust fans, five heating and ventilating units in the machine room, six heating and ventilating units in finishing and storage, two air makeup units for the machine room, four electric control room ventilation systems, one wet end exhaust fan, and locker and toilet room exhaust systems. The power required for this equipment is 468.75 installed motor hp.

Remove Large Volume of Vapor

In the manufacture of paper it is necessary to dispose of the large volume of water vapor that is released from the paper during the drying process. The low consistency pulp is formed into a sheet on the Fourdrinier and goes through press rolls where it reaches a consistency of approximately 67 percent water before it goes into the dryer sections where its moisture content is reduced to about 5 percent. This means that almost two tons of water must be evaporated for each ton of paper produced.

The drying section consists of a series of steam heated cast iron cylinders revolving at a constant selected speed. The sheet is held in intimate contact with the surface of the cylinders by means of "felts" (continuous wide cotton canvas belts) which, in turn, pass over separate drying cylinders. The dryer section is hooded and exhaust fans remove the vapors.

Establish Exhaust Rates

Exhaust rates from canopy type paper machine hoods are empirical. Good practice will vary from a 12 grains of moisture per cfm of air pickup in the deep South to 18 grains pickup in Canada, the variation depending on the ambient summer dewpoint and the practical relative humidity of the air leaving the hood. On an average, the air leaving the canopy hood will have a temperature of 130 to 140 F, with a relative humidity of 35 to 45 percent.

The new paper machine requires a hood exhaust rate of 340,000 cfm. Other exhausts, including a 60,000 cfm wet end exhaust, bring the total volume exhausted from the building to 413,000 cfm.

This exhaust is compensated for by outdoor air delivered by the heating and ventilation systems, together with air supplied to transformer rooms and motor control centers and the extra makeup units. The building is kept under a positive pressure.

Mix Indoor, Outdoor Air

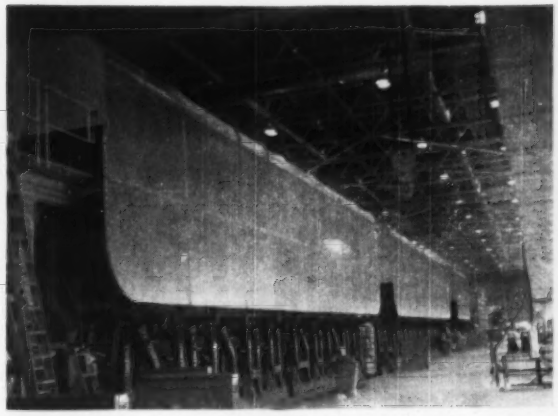
In the finishing, storage, and shipping areas, the heating and ventilating units are equipped with indoor-outdoor air mixing boxes with controls to maintain a constant air temperature going to the heating coils and full outdoor air delivery when outdoor temperatures are above 55 F. The winter mixture contributes to the building air makeup.

Humidity control during the heating season, in the form of water atomizers, is provided to keep finished paper from over-drying and to reduce static electricity caused by moving paper and machinery.

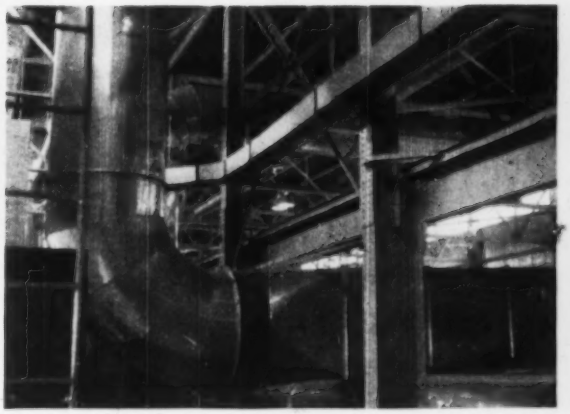
Spot Cooling Is a Must

In a paper machine room proper, the need for comfort heating is small except in extremely cold climates and during shutdown periods. The radiant heat from the drying cylinders, hot showers on the Fourdrinier, energy expended in driving the machine, etc., usually cause the room to overheat, even in the coldest weather. Spot cooling at the work stations is therefore necessary.

In the stock preparation and machine room areas, the heating and ventilating units distribute outdoor air over the underside of the roof and act as vapor absorption units to prevent condensation. These units have indoor-outdoor compensated temperature controls so as to raise the delivered air temperature as the outdoor temperature falls below a set point. An extension to the roof air distribution system delivers air



SUSPENDED HOOD, fabricated from aluminum corrugated sheets, is divided into three sections, with one over each dryer section. Continuous exhaust plenum is at ridge above hoods



MOISTURE LADEN AIR is exhausted from hood at 340,000 cfm via six fans in exhaust stacks. Outside air delivered by heating and ventilating system keeps building under positive pressure

to the operating floor for summer spot cooling. The diversion from the roof to the floor is by manual control of automatic dampers.

Keep Underside of Roof Warm

While the hood exhaust evacuates most of the water vapor, differences in vapor pressure throughout the room will cause the vapor to migrate. Also, there is a considerable amount of vapor given off into the room at the Fourdrinier, press section, and other places.

Experience has shown that the underside of the roof is the most vulnerable place for moisture to condense, with consequent — and most undesirable — drip. The vapor absorption properties of the air delivered by the roof system prevent this from happening. Moisture content of the air in various parts of the room is unpredictable, but experience has shown that 2 to 3 cfm of heated air per sq ft of insulated roof surface, keeping the underside of the roof at a temperature of 85 to 95 F, is adequate.

The extra makeup units temper the air in winter and are arranged to deliver the air for spot cooling in hot weather.

The air supplied to the transformer rooms and motor control centers is used to absorb heat given off by the electrical equipment and to pressurize the rooms. This air is tempered in cold weather. Air volumes are selected for a 10 F deg rise in absorbing the heat.

Prevent Coil Freeze-ups

Heating coils that handle, or might handle, all outside air are likely to freeze unless there is a full flow of steam in sub-freezing weather. To prevent freeze-ups, the automatic steam valves are of the two-position type so that at any time a thermostat calls for heat there is full steam pressure on the coils. The temperature of the delivered air is controlled by the modulation of coil face and bypass dampers.

Since this mill manufactures fine papers, all air is dust filtered through automatic filters. Also, air going to the electrical rooms passes through activated carbon filters. The mill uses chlorine and chlorine dioxide in its pulp bleaching process and vagrant corrosive gases from these are apt to reach these rooms unless filtered.

Other Air Systems Necessary

In addition to the exhaust and ventilation systems described, there are other air systems necessary in the manufacture of paper. These are:

1) A vapor absorption system that impinges high velocity heated air on the bottom felts in the basement so as to break the surface film of water and vaporize it so it can be picked up by the hood exhaust.

2) A system of high velocity jets of heated air blowing into and inducing air motion in the felt pockets (formed by the drying cylinders and felt guide rolls) to cause the moisture laden air in the pockets to move out to where it can be picked up by the hood exhaust.

3) A system blowing high velocity air through individually manually controlled nozzles onto the rolls of the calender stack in order that the machine tenders can control the expansion and contraction of the rolls. This air is sometimes lightly refrigerated to maintain a constant temperature.

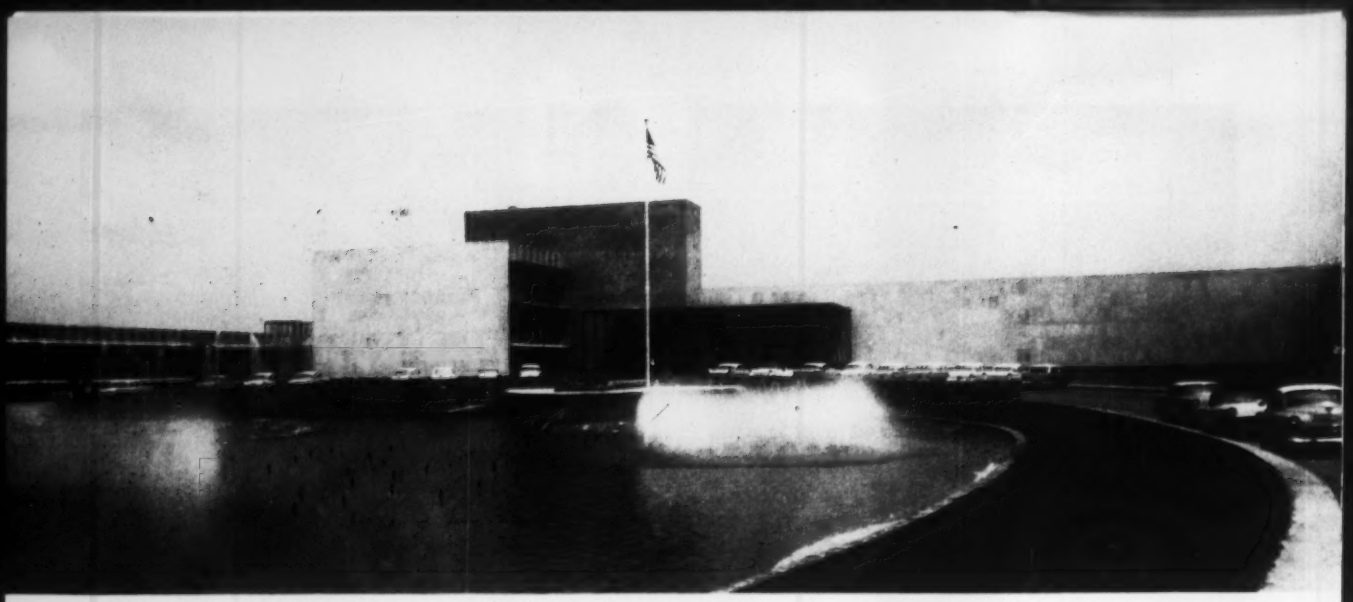
4) A pneumatic conveying system of the venturi type to dispose of the trim strips as the roll of finished paper is trimmed to width.

5) An air pressurizing and oil heating system for the gear boxes on the machine.

6) A motor cooling system for the variable speed direct current motors. The cooling air volumes and required terminal pressures are usually specified by the motor manufacturer, but the average will be 10 cfm per motor nameplate horsepower at around 1½ in. water gage.

A few areas are heated with steam unit heaters. All open shipping doors are flooded with heat from unit heaters that are inoperative when the doors are closed.

J. O. Ross Engineering Div., Midland-Ross Corp. was the mechanical (heating, piping, and air conditioning) contractor. ÷



ENGINEERING CAMPUS, where aircraft design, research, and development are carried on, is heated by low pressure steam, air conditioned by central built-up systems. Spray ponds, besides embellishing area, perform more important function of supplying condenser water for air conditioning

Preventive Maintenance Program Guarantees Continuous Steam

Critical nature of McDonnell Aircraft's jet fighter plane design and manufacture for the Navy and Air Force demands that there be no breakdown in mechanical facilities that would cause a production lag. Via its preventive maintenance program, 19 boilers supply constant steam for heating and process applications to buildings totaling more than 4 million sq ft of enclosed floor space. Air conditioning plays a major role, too—both for comfort and process applications, including keeping delicate electronic computers operating at top efficiency.

LOCATED adjacent to St. Louis' municipal airport, McDonnell Aircraft Corp. sprawls over wide area. Numbers are company's building designations. Buildings 1, 3, 21, 27, 42, 45, plus smaller unnumbered immediate structures, are supplied from central power plant

SPEED is today's yardstick of aircraft performance. It is the measure of the striking force that this nation must call on if it is ever drawn into a global war. The Air Force's F-101 "Voodoo" has streaked across the skies at speeds greater than 1200 mph. Still in the flight testing stage, the Navy's F4H is expected to reach velocities in excess of twice the speed of sound.

The design and production of these supersonic jet craft is a large scale operation — requiring extensive facilities to accommodate activities ranging from the drawing board to the flight line. Such is the operation carried on by McDonnell Aircraft Corp., St. Louis, developer and manufacturer of both the F-101 and F4H.

This huge installation of 4.1 million sq ft of enclosed floor area encompasses a main plant area with six larger and several smaller buildings totaling almost 2.5 million sq ft of floor space, design and research facilities comprising three structures enclosing 318,000 sq ft, and two more buildings totaling approximately 460,000 sq ft.

Nineteen separate boilers located in buildings throughout the area are involved in providing heating and process steam and air conditioning. These boilers have a combined generating capacity of 400,000 lb of steam per hr.

All buildings in the main plant area are heated from a central power plant. This facility comprises five boilers, three of which are capable of generating 65,000 lb of steam per hr, one of which can generate 60,000 lb, and one which is rated 25,000 lb.

Maintenance Is Full Time Job

Maintaining this tremendous amount of mechanical equipment is no easy task. McDonnell Aircraft employs a team of about 100 operating and maintenance personnel which devotes its full time for this purpose.

Each area requiring continuous attendance by operating personnel — the main area power plant and the central heating and air conditioning installations serving each of the other buildings — uses a chart system which lists each piece of equipment and the maintenance operation which is to be performed and the frequency of performance.

All other equipment — that whose operation is not supervised 100 percent of the time — is indexed on a "cardex" system. When new equipment is installed, all operating and maintenance procedures are reviewed and put on cards. These cards come up at predetermined intervals and are sent to responsible departments for their prescribed actions.

The preventive maintenance system is set up so that major overhauls on air conditioning equipment are performed during the winter months. Similarly, major heating equipment overhauls are done during the summer. This assures that vital equipment is in peak operating condition during critical operating periods.

Preventive maintenance "traveler" cards are sent to responsible supervision on a predetermined frequency, indicating what maintenance work is to be performed. Periodically, inspections are made to insure that work, as outlined on the cards, is completed as scheduled.

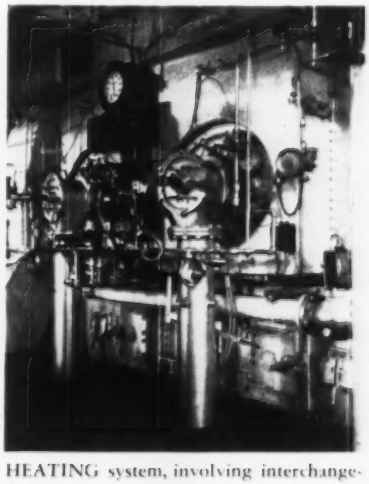
Histories are kept for each piece of equipment. These are reviewed periodically for unusually high cost items, repetitive repairs, or other factors which might indicate that engineering action is needed to reduce costs or improve performance, or may dictate changes in the frequency or scope of preventive maintenance on individual pieces of equipment.

A maintenance repair procedure supplements the preventive maintenance system whereby trouble calls are given immediate attention. Also, routine daily operating checks are made by personnel who are "operating maintenance men" as well as repairmen to reduce frequency of calls or prevent breakdown.

Lubrication of vital equipment is performed on a scheduled basis by special groups of oilers. Color coded lubrication points insure the use of the correct lubricants.

Where conditions dictate, specialized maintenance crews are utilized. These crews are supplemented, when necessary, from the central maintenance pool to handle large jobs.

That this maintenance procedure has paid off is borne out by the fact that in 17 years the plant has never been without steam.



HEATING system, involving interchange-burning of three fuels, uses separate gas and oil burners. Pulverized coal is blown into boilers when these fuels are not used. Changeover is made without load sacrifice

Deliver Steam at 175 Psi

Aircraft production cannot be interrupted since it is critical to national defense. Therefore there can be no fuel shortage which would cause work stoppage. Provision has been made for the interchangeable burning of three fuels — gas, oil, or coal — according to the demand.

Gas, available on an interruptable basis, is the primary fuel and is used whenever possible because it is lowest in cost. The local gas utility company gives a 2 hr notice when gas is to be cut off. At that time, one of the alternate fuels is selected.

As an example of the versatility of this "three-way" heating system, during an extreme cold wave in February of this year, the plant consumed 3402 tons of coal, 162,393 gal of oil, and 10,371,000 cu ft of gas. During one 24 hr period during this siege, about 170 tons of coal was used to generate 3,447,000 lb of steam.

Steam is generated at 175 psi. Via underground mains, this steam is

conveyed to reducing stations in each building where its pressure is reduced to 30 psi for heating and processing. High pressure steam ahead of building 42 is carried directly through the building to building 45.

Remote Buildings Independent

Buildings remote from the main plant area have their own individual steam plants. For the most part, these structures were erected later and at different times, and to have extended steam lines from the central power plant would have been unwieldy.

The recently completed Engineering Campus, where aircraft design, research, and development are carried on, comprises buildings 32, 33, and 34 — a total of 318,000 sq ft. All three are heated by low pressure steam; buildings 32 and 34 by 12 psi steam, and building 33 by 30 psi steam.

Low pressure steam was selected for heating the Engineering Campus primarily because these buildings are strictly office areas requiring no high pressure steam for process work.

Building 101, engaged in the assembly and testing of missiles and rockets, is heated by high temperature hot water. This is supplied by two 500 hp gas and/or oil fired boilers which generate HTHW at 300 F.

In addition to space heating, the system supplies — through a process loop — water for degreasing, plating, steam generation, dishwater booster heating, and domestic hot water heating, and for reheat coils in the office and cafeteria air conditioning units.

Air conditioning takes many forms at this installation — both for comfort and for processing.

The three buildings comprising the Engineering Campus are air conditioned throughout by central built-up systems. Each floor of each building is divided into three separate lengthwise zones for year 'round heating and cooling. Twelve thermostats are spaced at intervals in each zone and are regulated by operating personnel. Ducts are extended throughout false ceilings to perimeter outlets.

Condenser water for the Engineering Campus is supplied by two spray ponds. In addition to beautifying the site of these imposing structures, the ponds have large water-air surface areas. Through the use of water regulating valves, the sprays are controlled to provide just the right water evaporation rate.

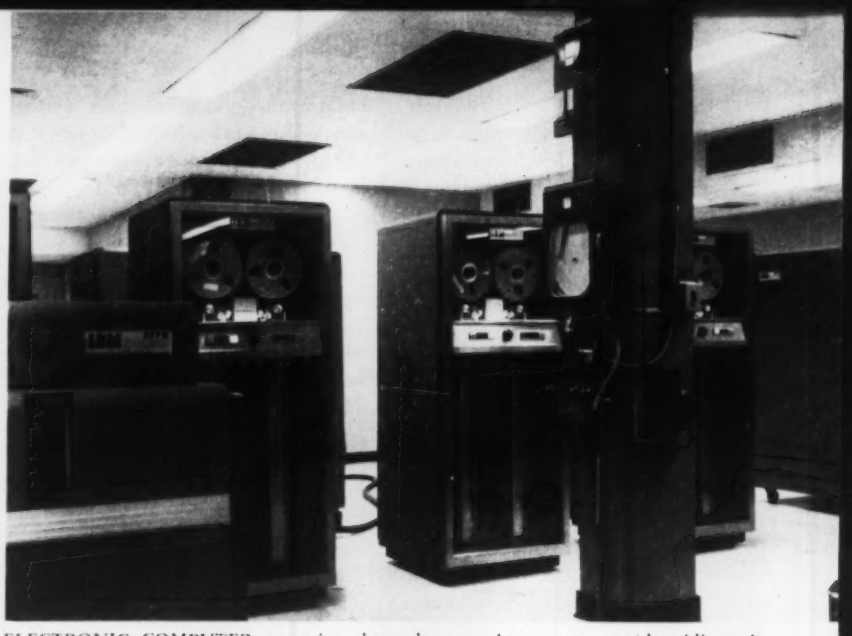
A similar spray pond serves building 102 located some distance away.

Air conditioning also has process applications which are critical to plant operation and aircraft design. Among these are humidity control in technical laboratories and calibration rooms, radar calibration, preflight checkout and calibration, spot welders, and hard coat operations.

The company maintains several electronic computer installations which must be kept within very close temperature and humidity limits. These complex mechanisms may operate incorrectly or break down if overheated, or the paper on which data is recorded may "stretch" or "shrink" if not kept at a prescribed relative humidity, thereby giving inaccurate results.

One such facility is located in the basement of building 1 and is situated amid a plant production area which is not air conditioned. To maintain 72 F (± 1 F deg) and 50 percent RH, conditioned air, from three 60 ton chillers located in a nearby equipment room, is admitted laterally through ductwork within the suspended ceiling.

Excess heat emitted by the computer equipment is returned through ceiling grilles via the plenum space above the suspended ceiling.



ELECTRONIC COMPUTER operation demands very close temperature-humidity tolerances. Conditioned air is admitted laterally through ductwork within suspended ceiling; excess heat emitted is exhausted through ceiling grilles via plenum space above suspended ceiling. Temperature and humidity recorder is under constant watchful eye of operating personnel

Simulate High Attitude Flying

A test chamber for simulating temperature conditions at very high altitudes is another process air conditioning application. Temperatures as low as −90 F are attained for testing various aircraft equipment under high altitude flying conditions equal to 100,000 ft.

A multiple compression system is utilized to obtain maximum cooling with minimum equipment since the reduced volume of rarefied air due to high altitude simulation imposes high demands on the air conditioning system. The system comprises two banks of three compressors each — low, intermediate, and high stage.

The editors acknowledge the cooperation of the McDonnell Aircraft Corp. plant engineering department in supplying the information contained in this article.

SAM LEWIS SAYS...

"False Economies Such as This Are Expensive in the Long Run

. . . cost of correction will indeed be extravagant"

ONCE I designed the heating and cooling of a one-story, basementless office structure about 600 ft square. I specified two sets of water circulating pipes, one with pumps for heated water and the other with pumps for chilled water.

The pipes were placed between and through the skeleton type trusses, so as to avoid any trip-over pipes at floor level across the many doors through the perimeter walls. I provided direct warm water radiators at floor level below windows. These are supplied from the overhead main pipes.

There were lots of posts, so the trusses were not very deep. Consequently, I arranged for many air supply systems, each in a rather low penthouse on the roof. Each penthouse contained an air supply fan with heat transfer convectors, dust filters, and an exhaust fan. The exhaust fan was arranged to discharge spent air vertically, so as to be independent of wind direction. Air for recirculation could be delivered to the adjacent supply system.

One group of private offices received air from a multi-zone plant. This plant was capable of delivering, under individual thermostatic control, the required volume of air to each room. Volume was constant; only the temperature varied. A single duct ran from the multi-zone unit to each room, conveying either heated or chilled air as required.

Contractors' bids for the installation were received. The owner, after considering them, fell for the criticism made by one of the bidders that it would be extravagant to duplicate the flow and return main piping (one for cold water and one for hot water).

Despite my protest, the plant was built with but one set of pipes for water distribution. The idea was that in the spring the warm water could be shut off and chilled water could be pumped through the same piping to the winter heating convectors.

The installation was made and was pleasing to all concerned during the first winter. The executives' offices each received a mixture of warm and cool air as needed; the cool air again being a mixture of outdoor air and 70 F recirculated air.

Then came the following summer. The general offices received relatively cool air, its surplus heat being removed by chilled water pumped through the convectors. If this air became too cool, the cool air leaving each air supply unit was "diluted" with some warmer outdoor air, as directed by a duct thermostat in each air supply system.

The executives' offices, with their individual mixing dampers from the multi-zone system, however, were prone to be too cool for some of the lightly clothed people. Since the heat-distribution system had been limited to one set of flow and return pipes, these pipes could *remove* heat but could not *supply* it.

Some of the private offices could receive air from one mixing damper at about 50 F, while air from the other mixing damper in the respective duct was no warmer than the recirculating air temperature, about 70 F. In mild weather these rooms became too cold. The girls may not have had cold feet, but they did acquire uncomfortably cold hands!

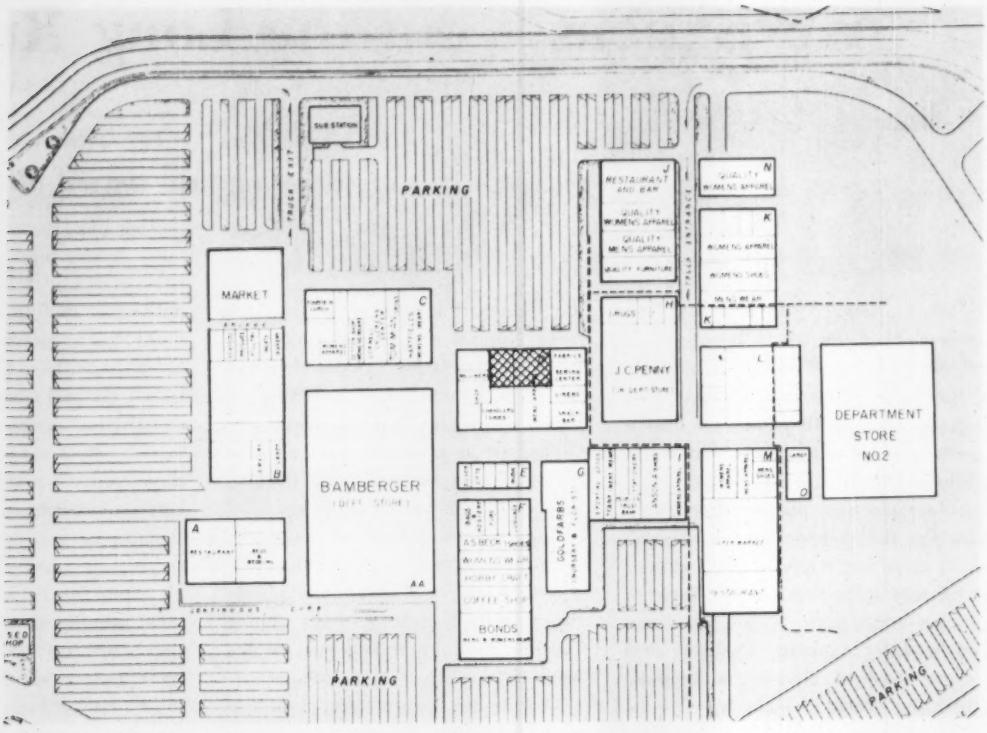
I cannot help but decry the mistaken hope of economy that deleted the facilities for furnishing heat as well as for removing it — *all year 'round*. False economies such as this are expensive in the long run. The cost of correction, involving new separate water piping, will indeed be extravagant.

We employed electric reheaters, still at no small cost, for boosting the temperature of the air on the mild summer days.

I believe in air conditioning. I believe that air conditioning means the ability to control the temperature and the relative humidity all the time, both winter and summer. The very nicest air is overcooled to drop its dew, and then is heated up to a comfortable temperature.

SAMUEL R. LEWIS, *consulting mechanical engineer and a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors, comments informally each month on practical problems in the field.*

HTHW System Tailor-Made to Meet



CENTRAL HTHW PLANT in store basement (cross-hatched area) heats individual buildings in huge Garden State Plaza shopping center. Plant also houses 4500 ton cooling capacity

BY RICHARD J. BUSH
Director, Mechanical Div.
Abbott, Merkt & Co., Inc.
Industrial Design Engineers
for Stores and Shopping Centers

EARLY in the design of the Garden State Plaza, a new regional shopping center in Paramus, N. J., the project's esthetics and economics both pointed to the desirability of a central plant as a means to heat and cool the entire development. Since this center is spread out over a 130 acre site, to consist ultimately of 16 major buildings and parking space for more than 8000 automobiles, many possible central heating system arrangements were possible.

Since well water isn't plentiful in the area, the heat pump was ruled out in favor of a boiler plant. In comparing the relative merits of a steam distribution system and a hot water system, the desirability of hot water heating made itself manifest for this particular job. Further investigation and studies narrowed this choice down to a high temperature hot water system as the logical solution—for the following reasons:

1) It offered the most economical initial cost of installation, as well as low operating costs

2) It utilizes the smallest diameter piping for equal capacity

3) It is least affected by long horizontal runs to remote points of consumption, whether at an elevation above or below the central plant location

4) It can provide medium pressure steam (10 to 60 psi) for various process loads throughout the center.

Having decided to employ HTHW as the heating medium, the details of the schematic system arrangement were still to be resolved, as well as determining the type of boilers.

Shopping Center's Design Limitations

Four boilers, strategically located in a central plant, supply steam which is converted to high temperature hot water. Unique arrangement was necessary because

- **headroom limitations made impossible the installation of an expansion drum above the boilers**
- **wide range of heating requirements dictated extreme operating flexibility**
- **economics demanded shaving costs wherever practical.**

Several methods for pressurizing an HTHW system are possible:

1) Employing an elevated tank

2) Using air or nitrogen

3) Providing an artificial head by means of a hydraulic pump

4) By steam.

After due consideration, it appeared that pressurization by steam was the simplest arrangement. It has been more or less standardized in many HTHW installations in this country.

Consider Various Types of Boilers

Both fire tube and water tube boilers have been successfully used for HTHW heating systems in a variety of different schemes. The following arrangements were considered:

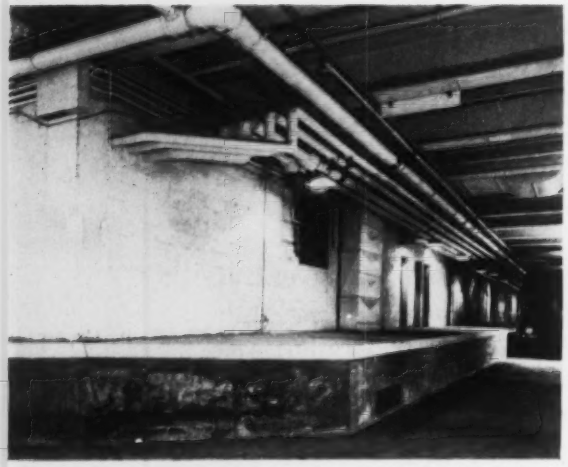
Fire tube boilers, especially of the scotch marine (or internal furnace) type which are commonly used as package steam generators, can be employed for moderate sized systems, either submerged (completely filled with water) or with a steam space to act as an expansion tank as well as a hot water generator. The advantages of these boilers—compactness, economy, efficiency, and ample room on the water side for natural circulation—lend them to this type of installation.

In the case of pump failure, these boilers would be in no serious predicament. They will cut out on either high temperature or high pressure, since the natural convection currents within the boiler would sense the stoppage of system circulation. In the case of coal fired boilers this is very desirable. A failure in electrical power could stop system circulation but would not extinguish the hot bed of coals. If the coal bed were not quenched immediately, serious damage could result to a boiler not having natural circulation.

One serious problem with these arrangements, however, is the danger of water that is too cold getting back to the boiler causing thermal shock which may fracture the tube sheets. This should be prevented by proper installation of adequate mixing connections.

Another point to consider also is the proper diffusion of the return water into this type of boiler to assure uniform temperatures across the length of the unit. Several manufacturers have incorporated perforated diffuser tubes in the bottoms of their boilers to accomplish this equalization.

Water tube boilers of the controlled forced circulation type have been very common in this country—especially on Air Force and other U. S. Government installations of moderate to large capacities. They are characterized by having no drums of their own. One type, designed specifically for HTHW applications, can have its convection surface mounted on top of the radiant surface. Or the convection surface—or so-called economizer section—may be located behind the radiant surface to minimize headroom requirements in the boiler room. This latter arrangement results in reduced construction costs in some cases. Another type, the "corner tube" boiler, has its convection



HTHW is conveyed to tenants via piping passing through loading areas. Requirements were that distribution piping system be as short as possible, that smallest piping be used

STEAM is condensed by return HTHW in cascade heaters. Circulating pumps deliver water from heaters' reservoirs to heating system or back to boilers. System shown here during installation

surface usually mounted behind the radiant surface and, therefore, also has a low silhouette.

The controlled forced circulation boilers may be arranged in numerous ways employing either one set of circulating pumps and a steam expansion drum, a surge drum using air or an inert gas for pressurization, or utilize a double set of circulating pumps, etc.

In an attempt to produce water tube HTHW boilers as packaged generators, one manufacturer has redesigned the conventional water tube steam generator with the usual steam and mud drums into a hot water generator. This unique generator, which has its own built-in expansion tank (the top steam drum), cannot only generate HTHW but also supply steam up to 10 or 20 percent of the total heat output, if required, for certain process uses or steam atomizing oil burners.

The final selection of the Garden State Plaza boiler plant arrangement was determined by the following conditions:

1) It had been decided that the central plant be located in the basement area of a one-story building in the center of the total future project in order to: (a) have the distribution piping system as short as possible and employ the smallest piping; (b) occupy space of the least value for merchandising or renting purposes; (c) have the least interference with parking or stock deliveries to the various tenants; (d) to be tucked out of the way so that these facilities would not be conspicuous nor unsightly. This location for the central plant presented such problems as isolating equipment noise so as to not annoy adjacent overhead tenants, and difficulties of removing products of combustion without getting them into the nearby courts and outdoor air intakes of tenant air conditioning equipment, etc. Another handicap imposed by this location, together with a relatively high natural water table in this area and hence the inability to excavate too deeply, was a very limited headroom for the size and capacity of plant contemplated. All these problems were overruled, however, by the above considerations favoring the central location.

2) The production or output of the plant would vary considerably from about 100 to 200 hp during the summer months up to 800 to 1700 hp during the coldest winter weather, with a possible maximum of 3500 hp for all future conditions.

3) The cost of such a plant had to be at a minimum so as to cost the project owner no more than individual heating plants in each tenant area. This limitation required the elimination of many items such as smoke indicators in the stack, CO_2 recorders, centralized panel board in one location for all essential controllers, and instruments of major items of equipment that are not absolutely necessary for plant operation but which are highly desirable by most operating engineers to get the utmost operating efficiency from their equipment.

Due to consideration (2), above, it was decided to employ four boilers for immediate needs; one small boiler to handle the summer load, two larger ones each sized for 50 percent of the maximum winter load, and one large standby boiler to replace either of the two large boilers when they are not operating.

Space was left for the addition of two future boilers. It was felt that this arrangement would allow the maximum flexibility between the light summer load and the heavy winter requirements, with the ultimate of boiler-burner efficiency for both the present and future loads.

Headroom Limitation Was Major Concern

Item (1), above, gave us considerable concern, since it is desirable in this type of system to have the steam expansion drum as high above the boilers as possible. Due to headroom limitations it was impossible to install a drum above the boilers. Therefore serious consideration was given to a scheme whereby steam expansion drums are part of the boilers. However, further study showed that these arrangements presented problems in the proper

distribution of return water to the various boilers in one system, and the maintenance of their proper water levels — especially between boilers of different sizes. So, a more suitable solution was sought.

On investigating the relative costs of the various types of boilers that are available today, it was quite evident that, if we were to properly satisfy the previously discussed limitations (3), we should try to employ package type water tube units for our larger boilers. This meant the generation of steam in such boilers rather than HTHW, since their basic design depends on the natural circulation of boiler water. They cannot be conveniently used for forced circulation without a serious redesign.

Cascade Heaters, Pumps Comprise Heart of System

The heating plant installed in Garden State Plaza generates steam in one 200 hp scotch marine type fire tube boiler during evenings, weekends, and summer; and in one or two package water tube boilers (each rated about 800 hp) as required during the winter.

Steam is conveyed to one of two open tray cascade direct contact heaters mounted on the floor adjacent to the boilers (headroom did not permit an elevated location). In these heaters the steam is condensed by the return HTHW being sprayed from the top of the heater and "cascading" down to the reservoir portion. Thus the steam is condensed into HTHW and its latent heat of vaporization is used to elevate the temperature of the returns from the heating system.

The water is sucked from the bottom of the reservoir of the cascade heater, through a mixing nozzle, into the HTHW system circulating pumps. The discharge from these pumps is divided into two paths, one to the heating system and the other feeding water back to the steam boilers to replace the water evaporated into steam. This, in effect, represents two paths of circulation, with both passing through the common cascade heater and circulating pump. This equipment may be considered the heart of the system.

The amount of water bled out of the HTHW circulating loop at the discharge of the circulating pumps depends on the amount of steam condensed in the heater (which in turn depends on the load imposed or on the return water temperature) as sensed and regulated by the feedwater regulator on each boiler in use. With this arrangement then, the water level in each boiler is automatically controlled by its feedwater regulator—independent of the level in adjacent boilers. Also, the water flow through each boiler is automatically controlled by these same feedwater regulators, according to the amount of the total load that each boiler is supplying.

Total water content of the system is sensed and regulated by float controls on the cascade heaters. Excessive water content due to intial heating and expansion is bled from the cascade heater through a water cooled blow-off tank. Additional water makeup as required for system losses (leaking valve stems, etc., which should be very small for this type of system) is fed into the boilers through a temperature controlled mixing or blending device to minimize thermal shock on the boilers.

Dual Fuel Firing Permits Cold Startup

The fuel for this plant is No. 6 fuel oil and is stored in three 30,000 gal tanks under the parking field. Space for a future fourth tank is set aside. The 200 hp boiler is arranged for dual firing of both No. 6 oil and gas. Thus, if for some reason the plant has to experience a cold startup, the small boiler can operate on gas to bring the system up to pressure and bring the heavy fuel oil up to operating temperature. At that point, the large boilers can be started on heavy oil without the use of auxiliary electric oil heaters and burner tips, although they are available in case of a gas shortage.

The small boiler may also be operated on gas for extremely light loads during weekends and in the summertime.

Other components of this system are more or less standard for boiler plants of this size. The sole exception might be the soot blowers for cleaning the boilers. These are of the "air-puff" type, utilizing compressed air rather than steam in order to minimize the use of steam for such purposes, thereby saving on raw water makeup.

Distribution mains from the central plant are generally run in the center's truck tunnel over the loading platforms and in the service corridor ceilings.

Installation May Be Model for Other HTHW Jobs

We feel that, although this system was tailor-made for the peculiar requirements imposed by this shopping center, it has achieved all of the advantages available in this type of system and, at the same time, overcome certain shortcomings. It therefore has points worth incorporating in other projects, where HTHW is the logical heating medium to be employed.

Central Plant Houses 4500 Ton Cooling Capacity

This center has also incorporated other mechanical features. A central chilled water plant in the boiler room houses two centrifugal refrigeration machines rated at 2250 tons of cooling capacity each for comfort cooling. As with other equipment, space is set aside for two additional units.

Each tenant of the project has been equipped with a special type of Btu meter for measuring his consumption of both HTHW for heating and chilled water for cooling. These are completely self-contained, requiring no outside source of power for motivation, and are accurate over a range of flow rates from maximum down to less than 5 percent of maximum.

The HTHW heating system serving the Garden State Plaza was designed by Abbott, Merkt & Co., Inc., industrial design engineers for stores and shopping centers.

How to Select Right Air Conditioning System for Multi-story Building

Performance characteristics and installation and operating costs vary among the many different types of air conditioning systems that are designed and installed today in multi-story, multi-room buildings. In the August and October issues, the author described the four main system categories—air-water, all air, all water, and refrigerant—according to their sensible capacities. In this article he shows how to equate performance against overall cost as a guide to system selection.

BY M. J. WILSON
Product Specialist
Machinery and Systems Div.
Carrier Corp.

WHAT ARE the functional advantages and disadvantages of the different types of systems that are used for air conditioning multi-story buildings? What are their "user benefits?"

We are primarily concerned with the maintenance of a satisfactory thermal environment in the conditioned space. Therefore, we are interested in the factors which affect our comfort. Their relative effect on our comfort and their order of importance are as follows: temperature, air quality, noise, air movement, humidity, and radiant effects.

Using the foregoing as a yardstick—regardless of the economics—the systems discussed may be rated functionally in the following order:

1) *All air* cooling with reheat
2) Double-duct
3) Dual-conduit
4) Induction
5) Radiant panel
6) Fan-coil with primary air
7) Fan-coil and outside air
8) Fan-coil and supplementary air from interior
9) Package units
10) Single-duct
11) Self-contained.

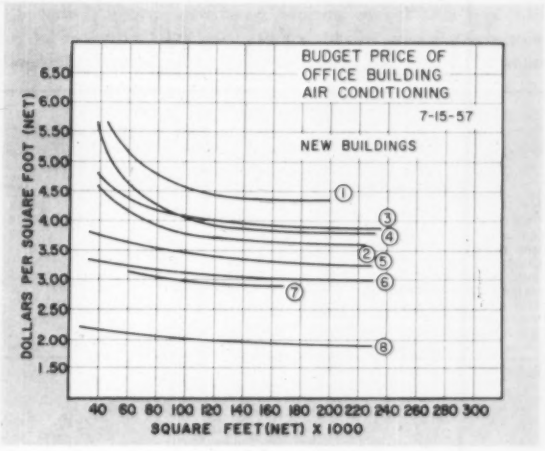
"User Benefits" Should Influence Selection

Based upon these ratings, there exist certain sales potentials for these systems. A quick review of Table 1 will indicate that the potential for the *all air* type systems is greater than for the *air-water* systems.

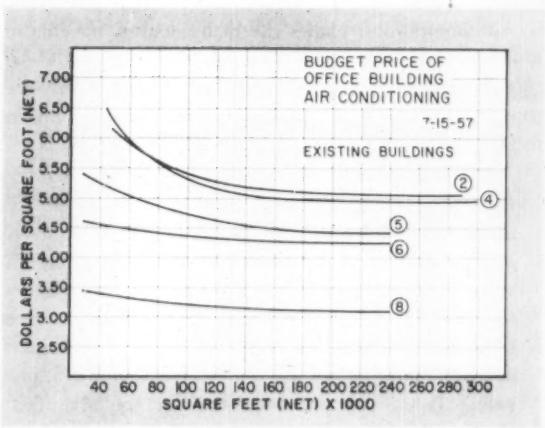
According to this one yardstick, a manufacturer would concentrate its efforts on promoting and selling the *all air* systems—if this were the only factor influencing the selection. Recall that the functional evaluation indicates that

TABLE 1—EQUIPMENT POTENTIAL sales volumes for various system types listed here in dollars per sq ft of conditioned area (exterior zone)

System name / System component	Double-duct	Dual-conduit	Single duct	Radiant panel	Induction	Fan coil and primary air	All air cooling and reheat	Fan coil and outside air	Fan coil and supplementary air	Package units	Self-contained window units
Preheaters	0.01	0.010	0.010	0.010	0.010	0.010	0.010	—	0.010	—	—
Filters	—	—	—	—	—	—	—	—	—		—
Dehumidifiers	0.238	0.210	0.195	0.06	0.052	0.052	0.195	—	0.04		—
Reheaters	0.040	0.020	0.040	0.020	0.015	0.015	—	—	—	1.05	—
Fans	0.128	0.128	0.128	0.045	0.030	0.025	0.128	—	0.020		—
Distribution system items	0.30	0.200	0.170	—	0.065	—	0.170	—	—	—	—
Room terminals	0.550	0.520	0.480	—	0.570	0.700	0.67	0.715	0.700	—	1.19
Water chillers	0.550	0.550	0.550	0.525	0.505	0.545	0.545	0.520	0.520	—	—
Cooling tower	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125	—
Room controls	—	—	—	—	0.300	0.300	0.158	0.300	0.300	—	—
Total, $ per sq ft	1.95	1.77	1.70	0.79	1.68	1.77	2.00	1.66	1.71	1.15	1.19
Total, $ per room	390.	350.	340.	160.	336.	355.	400.	332.	342.	230.	240.
Rating	2	4	6	11	7	5	1	8	5	10	9
Percent difference	115	104	101	48	100	105	119	98	101	69	71



1 COMPARATIVE COSTS or initial investments for various types of systems for new buildings are charted here. Systems are: (1) *all air*, conventional double-duct; (2) *all water*, with fan-coil terminal; (3) *all air*, unitary, low velocity plus under-window convectors; (4) *air-water*, with induction terminal; (5) *all air*, central station, low velocity, without convectors; (6) *all air*, package unit, low velocity, no convectors; (8) *refrigerant*, self-contained window unit



2 SIMILAR COST information given here for installation in existing buildings. Curves are numbered same as in Fig. 1

these systems rate above the *air-water* and *all water* type. Selling would not be too difficult if only the user benefits and manufacturer benefits were the influencing factors.

Such is not the case, however. A third, and perhaps the most important of all, is the owner or "customer benefits." More accurately expressed, this means the economic evaluation and justification for air conditioning.

If the owner and user are the same as in the case of an owner occupied building, then equating "user benefits" to "owner benefits" resolves into:

1) Increased worker efficiency
2) Reduced turnover and attendant costs
3) Reduced absenteeism, etc.

If the owner is reselling the air conditioning system benefits, such as is the case in a commercial rental office building, hotel, hospital, or apartment, then the problem of determining the best type of system for the particular project becomes more difficult.

Overall owning and operating costs must be determined within reasonable limits and then evaluated in terms of "user benefits." For example, it would be economically unwise to use self-contained window unit systems for the exterior areas in buildings such as the Prudential office buildings around the country. Such a system would undoubtedly have been low in first cost. Total owning costs, however, when weighed against user benefits would prove that such an approach is not correct for such a building.

There are many other examples which could be cited to show that the engineers and the owners have sufficient yardsticks to guide them in the majority of cases.

Can't Establish Overall Owning Cost Figure

It is impossible to establish an overall owning cost figure that could be used for all of the different projects. Many factors must be considered, such as building size and shape, usage, the particular area of the country, and the economic climate prevailing at the time.

Fig. 1, however, shows the comparative costs or initial investments for various types of systems for different sized new buildings. The scale at the bottom of the chart shows the air conditioned area or net rentable space in sq ft. The scale at the left gives the cost in dollars per sq ft. This information is for new buildings and includes equipment, piping, sheet metal, insulation, controls, tower, pumps, and toilet and machine room exhaust. Excluded are such items as electrical facilities, plumbing, boilers, heating for toilets, stairs and lobby, foundations, tower grillage, and construction of apparatus and machine rooms.

Fig. 2 charts similar cost information for installation in existing buildings. In this case the costs, in dollars per

TABLE 2—CHART rates various systems for typical, L-shaped, 12-story office building with 60,000 sq ft of exterior rental space, sensible cooling load of 42 Btu per sq ft. Systems are rated according to customer, user, manufacturer benefits. Lowest numerical index is best selection, highest is least practical

		Rating				Index	
2	3	4	5	6	7	8	9
System type	Depreciation period, yrs	Owner benefits (overall cost per sq ft per yr) New	Existing	User benefits	Manufacturer benefits	New	Existing
Double-duct	20	$0.69	$0.85	2	2	73	89
Dual-conduit	20	0.67	0.78	3	4	74	85
Single-duct	20	0.65[a]	0.67	10	6	79	82
Radiant panels	20	0.74	0.90	5	11	90	106
Induction	20	0.60	0.70	4	7	71	81
Fan coil and primary air	20	0.65	0.76	6	3	72	85
All air cooling and reheat	20	0.74	0.88	1	1	76	90
Fan coil and outside air	15	0.59	0.73	7	8	74	88
Fan coil and supplementary air	20	0.60	0.71	8	5	73	84
Package units	15	0.61[a]	0.66	9	10	80	85
Self-contained window units	10	0.55	0.64	11	9	74	84

[a] Includes under-window convectors

sq ft, include wiring, foundations, apparatus and machine rooms, steam piping revisions, cutting, patching, painting, plumbing, makeup and drains, and overtime in occupied areas. Also included is the equipment, piping, sheet metal, insulation, controls, cooling tower, pumps, and toilet and machine room exhaust.

Choose System For Typical Building

Assume an L-shaped, 12-floor commercial office building with 60,000 sq ft of exterior rental space in a midwest city. Table 2 shows the overall costs for several different types of systems which might be considered.

Column No. 4 shows that the overall cost per sq ft per year for the new commercial office building varies between $0.55 and $0.74. In an existing building the overall cost varies between $0.64 and $0.90 per sq ft per year, as shown in Column No. 5. The depreciation period for each system is shown in Column No. 3. The variations in these overall cost figures are due to several different factors. For example, the initial investment for the air conditioning of the office building is affected by:

1) Cooling load per sq ft

2) The value and area of usable space required for air treating equipment and the distribution system

3) Type of construction and attendant difficulties of providing the services for each module

4) Relative labor costs for piping and sheet metal work

5) Relative amount of overtime because of inconvenience to tenants in the existing building

6) Dependability and life of the existing steam lines and radiators

7) Depreciation period, etc.

Operating costs due to maintenance and routine servicing requirements will vary considerably for each type of system. Power costs are different because the cost of adding or extracting sensible heat with air is greater than with water. As an example, it requires approximately 250 times as much air as water, by volume, to provide equivalent cooling or heating.

Table 2 also shows the relative advantages of the various systems. Column No. 6 is a rating of the functional advantages of each system—"user benefits." The best system according to this particular criterion is an *all air* cooling system with reheat.

Column No. 7 shows the manufacturer benefits or, in other words, the system which would give the largest potential sales per sq ft of conditioned space. Here, according to the yardstick of largest sales volume per unit of effort, the best is the *all air* plus reheat system.

Based upon this information, what is the best system for this particular project? Remember, it is the exterior area of a commercial office building. The design sensible cooling load is 42 Btu per sq ft. This is very significant when determining the best system. The index figures in Columns No. 8 and No. 9 show that in both instances an induction system is the best. This index is the summation of overall costs shown in Columns No. 4 or No. 5, plus the rating factors for the user and for the manufacturer, shown in Columns No. 6 and No. 7. A review of the figures in Columns No. 8 and No. 9 will indicate that the lowest numerical index is the preferred selection. Having been checked on various studies, this index appears to give a ready indication of the proper type.

If the design sensible cooling load were only one-half of that selected, then the proper selection would have been some type of *all air* system. For example, in the new building a dual-conduit or double-duct system would have been chosen, and in the existing building an *all air* cooling and reheat system would have been selected.

An analysis of owning and operating costs for an *all air* and an *air-water* system, from the economic standpoint, favors some type of *air-water* system. Overall cost figures, based upon several different types of these systems, have shown the break-even point for the design cooling load to be between 25 and 30 Btu per sq ft. The table below shows this cost comparison for the range of sensible cooling loads from 5 to 65 Btu per sq ft.

Design sensible cooling load, Btu per sq ft	Total owning and operating costs, $ per sq ft per yr		Fixed charges, $ per sq ft per yr		Operating costs, $ per sq ft per yr		Value of usable space, $ per sq ft per yr	
	Air-water	All air	Air-water	All air	Air-water	All air	Air-water	All air
5	0.46	0.42	0.27	0.27	0.17	0.16	0.010	0.005
15	0.47	0.45	0.28	0.27	0.18	0.16	0.015	0.015
25	0.495	0.495	0.29	0.30	0.19	0.17	0.025	0.025
35	0.53	0.55	0.31	0.33	0.195	0.19	0.025	0.030
45	0.57	0.605	0.335	0.36	0.205	0.21	0.030	0.040
55	0.61	0.665	0.36	0.39	0.22	0.23	0.030	0.050
65	0.64	0.73	0.39	0.43	0.23	0.25	0.035	0.055

Contractor Reports Plan to Install HPAC Systems on Lease Basis

Innovation will eliminate need for user's initial cash outlay, give him option either to renew lease or to purchase system after term of lease has elapsed. This marks first time that entire central systems will be installed under such a plan.

A REVOLUTIONARY new plan which will permit installation of complete air conditioning, heating and ventilating systems in new or existing buildings without the investment of any capital is announced by Frank Hudik, president of Hudik-Ross, Inc., mechanical (heating, piping, and air conditioning) contractors, of New York City and Hackensack, N. J.

The plan marks a broad new application of the leasing principle which has demonstrated many practical and financial advantages throughout the business world.

To be known as the Hudik-Ross Leasing Plan, it will be applicable to mechanical contracts in virtaually every type of structure, including office buildings, industrial plants, shopping centers, hotels, hospitals, and apartment houses. While smaller, packaged air conditioning units have been available under lease in the past, this marks the first time that entire heating and ventilating systems including piping, sheet metal and electrical work, as well as complete central cooling systems, will be leased.

Under terms of the plan, Hudik-Ross will supply and install air conditioning, heating, and ventilating systems under a leasing agreement for a base period of from two to seven years, with unlimited renewal periods. The lease involves no initial cash outlay. Citing a typical example, Mr. Hudik said that a five year lease plan for a $100,000 mechanical installation would call for a rental of about $2000 a month, the first payment to be made upon completion of the job. Upon expiration of the agreement, the owner may renew the lease on a year-to-year basis at an annual rental amounting to 5 percent of the original contract price, or, in this instance, $5000.

After the initial leasing period, the owner may request an option to purchase the equipment. The purchase price is set at 10 percent of the original cost of the installation, where that cost was over $10,000. For smaller systems, the price is 12 percent of the original cost.

The exact monthly rental will be based on three factors: the cost of the installation, the length of the lease, and the credit rating of the lessee.

To the owner of an existing strucure which is to be air conditioned, the plan means that the improvement can begin at once with no cash outlay. If the mechanical work is part of a larger modernization project, the capital required is reduced by the amount of the mechanical contract. Mr. Hudik points out that this immediate availability has special significance in such properties as office buildings, hotels, motels and stores, where air conditioning has become a virtual competitive necessity.

In the highly competitive rental office building field, Mr. Hudik notes that air conditioning raises rental values in today's market by as much as $1 per sq ft, increasing rental income by up to 30 percent. Under the lease plan, the owner gains competitive advantage while realizing a substantial new profit above the cost of the rental.

To the builder or industrial firm which plans to erect a new structure, the plan will have the effect of reducing the cash investment as well as lowering the dollar value of the mortgage. The amount of mortgage financing that might be arranged for a new $2 million structure, for example, is about 60 percent, which means that the builder would have to put up $800,000 in cash. Under the new leasing plan, subtracting the cost of the mechanical equipment, which represents as much as 20 percent of the total, the same building might cost about $1.6 million. With similar financing terms, the plan would reduce the cash investment by $160,000 and lower the mortgage by $240,000.

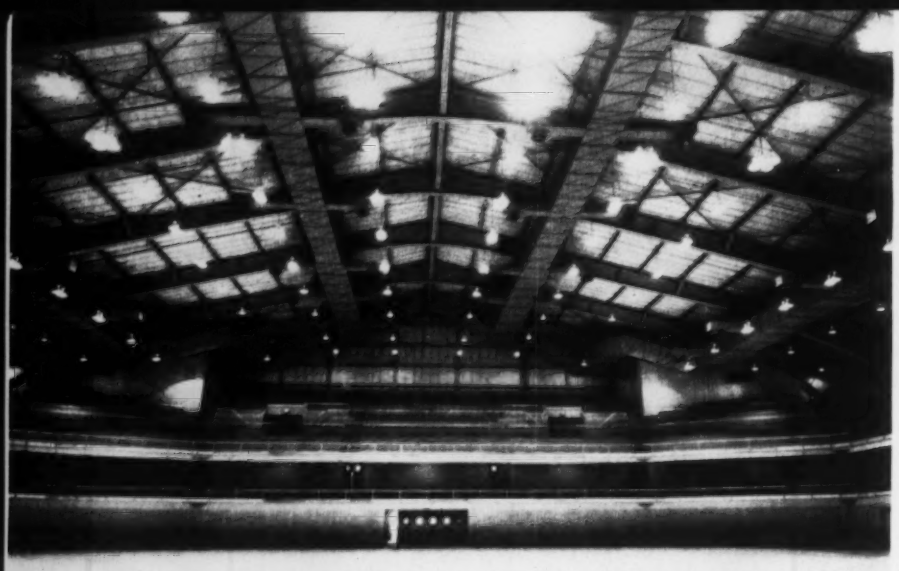
Mr. Hudik cited several reasons why many companies find leasing more profitable:

1) It keeps working capital from being frozen in fixed assets. While the total cost of leasing is a little more than the cost of purchasing, the extra available capital can bring a return that far exceeds the additional cost of leasing.

2) It may also give major tax advantages. As operating expense, rentals are fully deductible. Therefore, when leasing, a company pays for the use of its equipment out of current income before taxes, rather than from profits after taxes.

3) It does not affect a company's financial ability to borrow.

4) Frequently, monthly rentals are lower than installments under a conditional sales contract or repayment of a bank loan. Since the term of a lease is generally longer than the term of a conditional sales contract or a commercial bank loan, a company's current cash position again benefits from spreading out the cost of using the facilities.



FOUR DUCTS run length of University of Tennessee fieldhouse. Air diffusers, 64 in all, are mounted on arms extending out on each side of main ducts. Arena seats 14,000

Lack of Design Precedent Made This Heating, Ventilating Job a Tough One

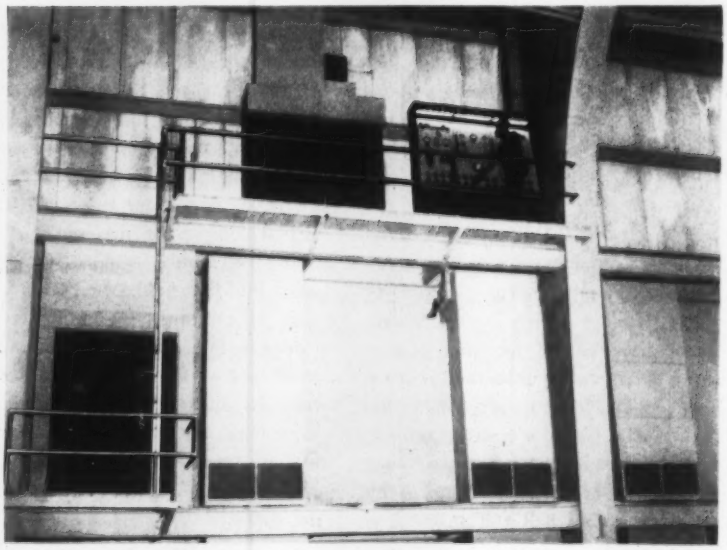
BY CHESTER E. McCALLUM
Mechanical Consultant
Barber & McMurry
Architects, Engineers Associated

With little general information published on heating and ventilating large arenas, the designers of the system serving the new University of Tennessee fieldhouse had to visit other buildings of this type to gather design data

FOR MOST proposed heating and ventilating projects there exists a design precedent—a guide. This is found, usually, either in the literature or the ASHAE Guide. While the precedent is, of course, something less than a complete solution to the problem, it can set a pattern or basis to go on.

Recently, however, while working on the design of the heating and ventilating system for the new University of Tennessee fieldhouse and armory, we searched in vain for information that might help us with the problem: an open, 47,000 sq ft arena that will eventually seat 14,000 persons for events ranging from basketball games to graduation ceremonies.

Our search proved one thing: that very little general information is in print on the subject of heating and ventilating such large areas. We found it necessary to make a field trip, visiting and viewing first-hand five fieldhouses in as many states. The things we learned on the trip were of



HEART OF SYSTEM is central control panel mounted about 35 ft above arena. From this vantage point, operator can control entire system, dealing quickly with bad smoke conditions, hot spots, or dead air. Eight strategically located thermometers report ambient temperatures to control panel

invaluable assistance in shaping our final design.

For instance, we learned that flexibility and central control are prime requirements in ventilating such a large area. Flexibility is necessary because with large areas a variety of high temperatures and smoke might be present at the same time. Central control is desirable so that one man can operate the entire system.

Design for Expansion

Built this year at a cost of $1.5 million, the new University of Tennessee fieldhouse and armory incorporates most of the latest developments in this type of construction. Besides the arena, the building houses dressing rooms, ROTC offices and quarters, and various storage areas.

One of the unique architectural features of the building is a rigid frame span measuring 205 ft across from center to center. The arena itself is rectangular in shape and measures 215 × 180 ft, more than adequate for present needs.

However, expansion, a likely development in view of the steadily increasing enrollment at the university, can be provided by simply removing the end or west wall and repeating the design of the present structure.

Air Enters via Two Large Ducts

Ventilating or heated air is introduced into the fieldhouse through two ducts, each of which measures 108 × 72 in. at the entering point. Just inside the arena, the two separate into two more ducts each for a total of four which run the length of the arena 5 ft beneath the ceiling. The ducts narrow 9 in. at each of eight takeoff points, ending with a measurement of 30 × 25 in. at the final takeoff point. Entering the duct, the air velocity is 1700 fpm. At the final takeoff point, it is down to 1200 fpm.

Because of budget limitations, we realized there was little or nothing we could do about disguising the ductwork. So we did the next best thing: make them as prominent as possible with bright orange paint. The result has been quite an unusual and pleasing architectural effect against the gray ceiling.

Two high bay circular air diffusers are suspended from each takeoff point, for a total of 64 air diffusers in all. In addition, to handle the unusual conditions found in the upper and lower spectator galleries, wall grilles are used.

The air diffusers attached to the two center rows of ducts are 50 ft above the floor, while those attached to the two outside rows are 35 ft above the floor.

Fans Handle 91,500 Cfm Each

Two huge fans move more than 180,000 cfm of air into the arena, providing 4½ complete air changes per hour. In our visits to other installations we found some systems giving as high as seven air changes per hour and others only two. Actually, our research and experience with this installation indicates that four to five is the optimum.

Since the rooms housing the fans and heating coil plenums are immediately behind the spectator galleries, it was imperative that the fans operate quietly so as not to disturb the various events held in the arena. The high capacity per horsepower and low noise level characteristics of the centrifugal fans selected answer this need.

The mechanical equipment in the entire installation—fans, diffusers, ducts, etc.—provides very satisfactory sound conditions. Our tests indicate that the equipment is inaudible from any point on the arena floor or in the galleries.

Vantage Point Aids Control

Heart of the system is the control panel, situated about 35 ft above the arena floor on the north wall. Access to the panel is by a ladder from the arena floor to a catwalk directly in front of it. From this vantage point, the operator has complete control over the heating and ventilating systems.

Stop and start controls for the fans as well as 14 pneumatic damper positioning switches are located on the control panel. Eight thermometers located at strategic points in the building indicate ambient temperatures to the control panel. Also indicated on the control panel are mixed air temperature entering each coil, discharge air temperature, and modulating steam valve position (controlled from average space temperature). Thus, the operator is able, with the damper system, to remove hot spots and dead air, particularly from the galleries.

From his vantage point on the catwalk, the operator can also maintain a visual check on smoke. If smoke accumulates in any sizable amount at one point, he can concentrate exhaust air movement on the area and quickly dissipate the cloud.

Outside Air Needs Vary

Normally the system uses about 20 percent outside air mixed with 80 percent return air. But, if desired, it is possible to bring in 100 percent outside air.

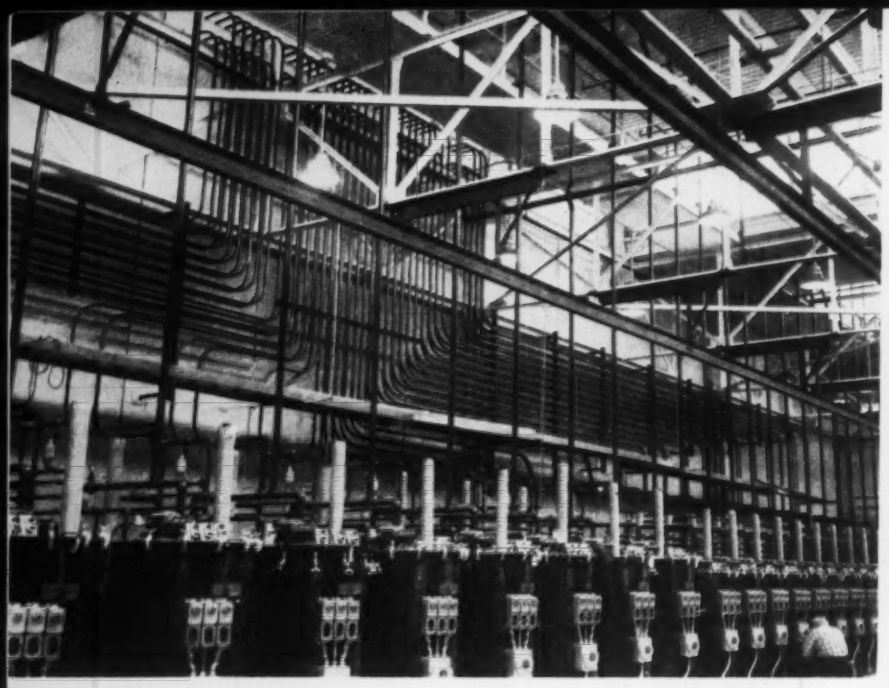
Steam coils on the suction side of the fans are served by a 12 in. line from a single 150 hp boiler which serves all of the heating needs of the fieldhouse. Space is set aside for another boiler in the event of expansion.

Return air in the system is handled at two levels, one with grilles at floor level and the other with grilles about 12 ft above the floor. The two ducts are so situated to provide more uniform air circulation, particularly in the vicinity of the upper and lower spectator balconies.

Heat that concentrates at the peak of the ceiling, 62 ft above the floor, is removed through a gravity ventilator that runs the length of the arena. In addition to providing egress for dead air, situating the ventilator here helps prevent condensation from forming on the purlins.

Barber and McMurry were the architects and engineers. Malcolm H. Rice, consulting architect for the University of Tennessee, was overall supervisor on the project. Temperature Control, Inc. and Cureton Plumbing and Heating Co. were the mechanical (heating, piping, and air conditioning) contractors. ‡

Photos courtesy Chicago Blower Corp.



TUBING emanates from paint tanks to convey an array of colors to spraying booths on Lincoln's production line

New Cars Get Paint Jobs Via 25 Miles Of Silver Brazed Lightweight Piping

PRODUCTION of today's automobile involves the application of many colors requiring an equal number of paint lines. About 25 miles of such piping has been installed in the new Lincoln assembly plant of the Mercury-Edsel-Lincoln Div. of the Ford Motor Co. at Wixom, Mich.

All of this piping had to be fitted into a minimum of space. Each line must permit smooth, even flow of the viscous paint. It cannot leak at the joints, has to be easy to clean, must have a minimum pressure drop, must bend easily to get around obstructions, and has to be accessible for installation and maintenance.

This piping had to have very close OD tolerances to permit satisfactory brazing or soldering, and an expanded end on each length which could be held to very close ID tolerances for the same reason.

Paint spraying, to be done satisfactorily, must have a minimum pressure drop through its piping system. It is therefore imperative that the inside surface of the piping have a smooth, uninterrupted surface—even after joining. Silver brazing was selected in this case as the best way to achieve this, and also to reduce the possibility of leaks at the joints. Prior to installation, each length of tubing was hydrostatically tested at a minimum pressure of 1000 psi—more than adequate for the 110 psi top working pressure for the paint system.

Besides maintaining constant pressures, the smooth inside surface of the piping facilitates easy cleaning. Flushing with solvents is usually enough.

If emergency repairs are necessary, a line can be cut and inserts put in—without heat—with flareless fittings.

In installing the system, it was necessary to apply heat to only a small portion of the expanded end tubing or fitting with an acetylene torch. When the proper temperature was reached, the brazing wire was applied at the junction and flowed by capillary action to produce the seal. The surfaces to be joined were previously wiped with a fluxing agent. Automatic cleaning tools were used to clean the ends to be joined to be sure no foreign matter would prevent proper wetting action.

Outlets from the line were made with malleable iron tees or expanded end tubing with threaded pipe outlets. Joints that require breaking were made with forged or malleable unions, or with pipe flanges bolted and gasketed.

Since the brazing operation required the application of heat on only a small portion of the circumference of the tubing, joining in most hard-to-get-to spots could be performed. Where obstructions or tight spots did occur, the tubing was readily bent, using a power bender, to avoid such situations.

The paint line system was installed by the DeVilbiss Co. The piping subcontractor was Lorne Plumbing and Heating Co. ≠

Photo courtesy Standard Tube Co.

INDUSTRIAL VENTILATION:

How to Design for Heat Recovery

BY JOHN H. CLARKE
Engineering Design Supervisor
Air Conditioning and Power
Visking Co.
Div. of Union Carbide Corp.

Big savings in winter heating costs of industrial plants can be effected through well designed heat recovery and conservation systems. Why waste heat from hot equipment and processes to the outdoors when it can be put to good use in cutting heating bills? Several examples of using this means to reduce heating loads are in operation today. The author, in previous articles has presented details for the proper design of these systems. Here he compares installation costs for a built-up system and a system made up of several packaged units.

NO INDUSTRIAL ventilation system of any size should be designed without considering the economic aspects of heat recovery and conservation. It is important that heat be recovered from process and other sources and used for tempering the ventilation air wherever practical, and that the air be tempered as economically as possible.

Today the ventilation requirements of industrial plants have become enormous. Some plants require volumes of 3 to 5 million cfm of makeup ventilation air. To meet these needs boilers must provide steam or equivalent capacities of approximately 240,000 to 400,000 lb per hr to heat the air through a 70 F rise.

The heat required to temper this air may be as great or many times greater than the process heating loads in the winter. For a system operating 24 hr per day, seven days a week (the case for many plants today) at an average heating season temperature of 38 F for a six month heating season it would cost about $95.00 to $157.00 per year per 1000 cfm to heat the air to 70 F. This is based on direct steam costs (fuel, labor, and maintenance) of $0.60 to $1.00 per 1000 lb of steam, the usual range for most plants. For a 100,000 cfm system this amounts to a heating cost of $9500 to $15,700 per year. It is evident therefore that important savings can be realized by reducing the heating loads by any possible means. Here are some of the ways this can be done:

• Mix Supply Air with Hot Building Air

One way this can be done is by leading the air over hot equipment, such as boilers, kilns, furnaces, motors and engines, and similar equipment of high heat load. It can also be accomplished by injecting the supply air into hot areas in such a way that it is forced to mix thoroughly with warm air before reaching the work zone. Alternate discharge openings in the ducts (or directionalizing by outlet positioning) are usually necessary so that the system can provide summer relief ventilation.

The amount of air that can be provided over hot equipment or areas will depend upon the available heat from such equipment or process and the manner in which the air is introduced into the space. Direct impingement that would adversely effect the process or equipment and create objectionable draft conditions in the work zones should be avoided.

In boiler rooms the intake louvers can be provided high, up, over, and in back of the boilers. The forced draft inlets can then be located in the same general area. Summer relief air can be provided by separate ventilation to the operating stations on the firing aisle.

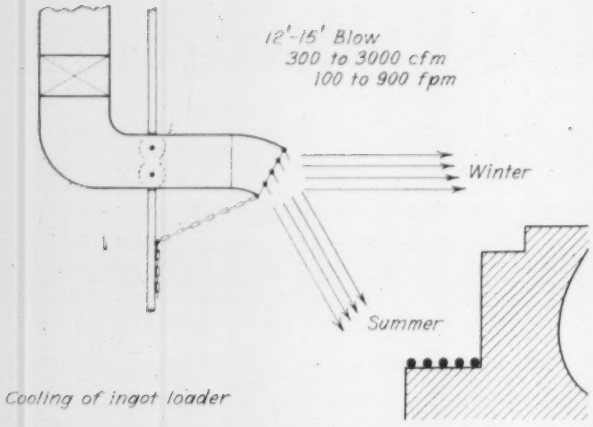
Fig. 1 shows an installation using directional outlets.

The directional outlet shown in Fig. 2 is another type which can provide relief air in the summer and can also facilitate good mixing with warm air in the winter so as to permit reduced delivery temperature. In such cases some tempering of the supply air is required, the amount depending upon the winter heat relief requirements and the heat available in the area. But substantial savings of 20 to 30 percent in heating load may be realized by such systems because the air can be introduced into the area at a much lower temperature than would otherwise be necessary.

In some heat treating areas reversible roof fans have been used to exhaust the area in the summer. In the winter the fans are reversed and then handle about 50 to 60 percent of summer capacity (the fans are less efficient in the reversed condition) to provide makeup air (tempered by the area equipment heat) for burners, hoods, and other requirements. Summer makeup is supplied through windows.

Directional grilles and diffusers are available that permit directing the supply air either at a relatively high

The author is a member of the technical advisory committee on industrial environment of the American Society of Heating and Air-Conditioning Engineers. He has written several articles for Heating, Piping & Air Conditioning on the various aspects of design, operation, and maintenance of heating, ventilating, and air conditioning equipment and systems in industrial plants.



1 DIRECTIONAL OUTLET for ventilation and makeup air saves heat in winter because air can be supplied at lower temperature. This will permit 15 to 20 percent savings in tempering load. In this case, air is also mixed with hot air rising from equipment, resulting in further savings

level (up or horizontally) for winter operation or down for summer heat relief. These are operable readily from the floor and are being used in many industrial plants to accomplish the multiple purposes of winter heat saving (through good diffusion at high level, and thus a lower supply air temperature) and summer relief.

● Pass Supply Air Through Heat Exchangers

This can be done by warming the supply air with hot water or heated liquids being wasted, by hot exhaust gases, or by means of high temperature air being removed from equipment or processes. Air heaters similar or identical to ventilation air heaters or boiler preheaters may be used. Regenerative air heaters for heating air with waste gases are commercially available.

Fig. 3 indicates an elementary but practical means of recovering engine exhaust heat. In such installations the cold outside air passing over the exhaust pipe will cause condensation and a corrosion problem unless proper materials are provided for the exhaust pipe. In addition, waste heat exchangers have long been available commercially for recovering the exhaust heat from diesel and gas engines.

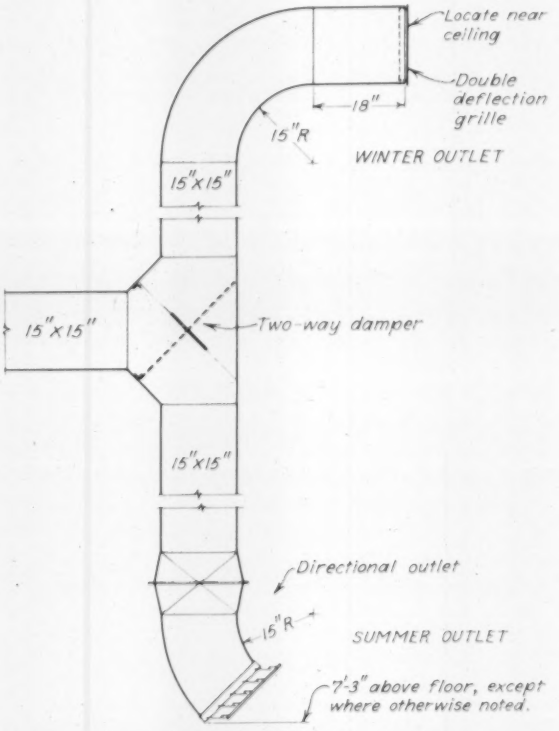
The success of this type of recovery would depend upon the continuous operation of the heat producing source during the hours for which supply air is required, and the grouping of the equipment and its relative location to the makeup air systems. Temperature control can be provided by bypassing the heat exchangers. Conventional types of air handling equipment can be used to circulate the air.

● Heat Air by Cooling Process Equipment

This method whereby the supply air is warmed in cooling process equipment, motors, or generators is similar to that just described. However, in this case the air heating would be done directly by the equipment involved. Fans, which may be capable of moving the required air, are incorporated in motors, generators, engines, and many other types of equipment big enough to make heat recovery practical. A system of this sort may be used to provide clean, filtered air to the equipment; heat recovery in the winter; and a reduced heat load in the summer.

Fig. 4 indicates an outstanding example of what can be done along this line. In the textile spinning room shown, an exhaust system is provided for each spinning frame to remove airborne lint. This air is led to the top of the enclosure where the waste is filtered out. It is then drawn down through the motor compartment to cool the motor, exhausted from the spinning room, and discharged to an air washing room. From here the air is either discharged to the outside or back into the mill, depending upon weather conditions and heating requirements. It should be noted that the heat recovery feature of this installation could not justify the cost of the system. But it can be justified as a part of a *multi-purpose* system. Aside from the ventilation and heat recovery features, the system extends the life and reliability of the spinning frame motors.

Another type of heat recovery is shown by Fig. 5. Here,



2 IN MANY AREAS where heat is given off by equipment there is no real space heating problem in winter. Problem is to provide heat relief in the summer and to maintain required makeup air volume at all times. This type of directional outlet permits all or part of the air to be directed to the work zone as indicated. In winter, air can be discharged near the ceiling where it will mix with warm air rising from equipment. This not only permits lower supply air temperature, which reduces heat load, but dry air supplied from outside may also reduce or eliminate a ceiling condensation problem

Notes and Corrections

My attention has been called to the fact that in Fig. 1a no belt guard is shown for the fan. This was done, perhaps erroneously, for the sake of simplicity. As stated in the October issue, belt guards should always be provided, whether outside or *inside* the casing. In specifying the expanded metal for *all* guards, this should have been noted as ½ in. expanded metal (catalog designation is ½-16-18 or ¼ in. × 1 in. × 16 ga).

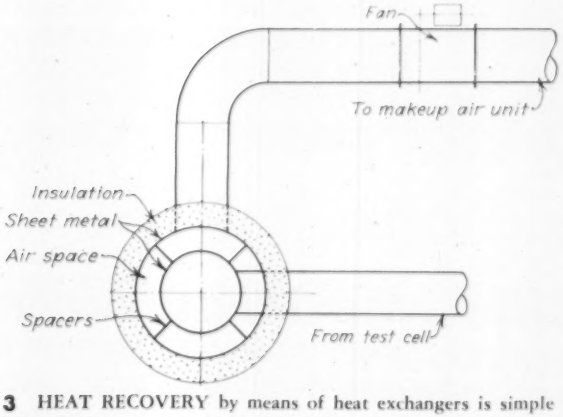
Also, for the system inlets the expanded metal for the bird screens was shown as ¾ in. × 1½ in. × 16 ga. This should be ¾ × 1¾ × 16 ga (catalog designation ¾-16-18).

In the August issue sheet metal gages and stiffening were indicated for various sized systems. Such a table must be very general because it does not take into account the sizes of the flat areas which must be stiffened. From Fig. 1a it is apparent that for a double inlet fan installation the flat areas are extensive. The required stiffening should be carefully engineered for the specific job requirements.

JOHN H. CLARKE

a group of hot vessels is being cooled (it is assumed that contaminating fumes are not evolved) in a refractory enclosure. Air from the surrounding space is drawn through the enclosure by an exhaust system which either discharges the air to the outside in the summer or into the building as needed in the winter.

Heat recovery from power equipment is shown in Fig. 6. This installation was made in the pump rooms of the "Big Inch" pipe line[1]. The cooling air for the pump motors is drawn in the ends of the motors and is discharged at the top. The motors are hooded and an exhaust system then discharges the hot air either to the outside or back into the building as required for building comfort and heating. In this case a simple and elementary exhaust system provides an excellent means of heat recovery which is far more effective in controlling the building temperature than if the hot cooling air were allowed to blow directly into the motor room. Similar installations



3 HEAT RECOVERY by means of heat exchangers is simple but effective means of recovering heat from engine or hot process exhaust. For engine exhaust the exhaust pipe must be of suitable material to resist severe corrosion. Other types of heat exchangers such as tubular type are also available where installation cost can be justified

4 HEAT IS RECOVERED from 15 hp motors of 90 spinning frames in cotton mill spinning room. Exhaust system for each frame picks up lint which is filtered out in compartment above motor. Air is then drawn down over motor for cooling and then is either exhausted to outside or discharged back into ventilating systems when heating is desired. This results in heat recovery and longer life and reliability for motors. These advantages are gained by modest additions to ventilation systems that are otherwise required for the mill building

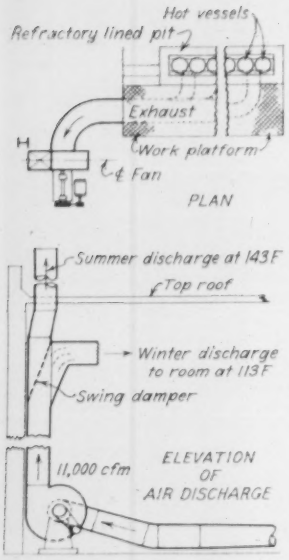
have been provided for many industrial plant motor rooms and for ship generators.

● Recover Hot Air From Adjacent Areas

This is a much neglected source of tempered makeup air for industrial areas. It must be clearly understood that unacceptably contaminated air should never be moved into adjacent areas. The ventilation or air conditioning systems serving office, shop, or plant areas which are reasonably uncontaminated by dust or fumes should be designed to discharge the exhaust to areas requiring makeup air wherever possible, instead of discharging to the outside. Even though the systems may operate mainly on recirculation, the air exhausted would be of suitable quality for makeup. It is possible that the same air could be moved through two or three areas successively before finally being removed by process, hood, or other exhaust systems. For instance, office system exhaust can be discharged to a clean plant area and then flow to adjacent areas for hood or process makeup. It might also discharge to locker room areas and from there to toilet or shower spaces.

In laboratory buildings the office supply systems can be designed for 100 percent outside air. The exhaust can then be permitted to flow or can be mechanically moved to adjacent laboratories having hoods. This is common practice. For radiochemical laboratories, which are kept under a slight negative pressure and have air locks, the exhaust from the offices must be moved mechanically and

[1]*The Big Inch Pipe Lines . . . a Double Barreled Gun*, Heating, Piping & Air Conditioning, July 1945, pp. 363-367.



5 AIR DRAWN from surrounding areas is heated by hot process vessels. Hot air is then exhausted mechanically to outside in summer or back into building in winter when heat is needed. In such cases, designer should check carefully to be sure that objectionable odors or fumes will not be given off by hot product or equipment

6 IN RECOVERING HEAT from "Big Inch" pumping station motors, cooling air for motors is drawn in at each end and discharged at top. Hoods are provided and warm air is removed by mechanical exhaust system arranged to discharge air to outside or back into building. Considerable heat savings are effected. In many cases, motors or generators can be provided with fans which will draw cooling air through filters to provide clean air and then discharge it through short ductwork to provide heat recovery as needed

be introduced into the laboratories in a manner which will not disturb the efficiency of the hoods.

In some motor generator rooms of steel mills, air is supplied that has been filtered or evaporatively cooled (or both). These rooms are slightly pressurized to keep them clean. The supply air picks up heat from the motor generator sets and is discharged to adjacent plant areas.

An automotive plant uses a similar method. In this case the motor generator room is on a mezzanine and the floor of the space has a steel grating, sized to keep the space under positive pressure. The clean supply air is discharged at points over the motor generators where it picks up heat. It then flows through the floor grating to the plating area below. According to motor manufacturers, such installations are quite common in large industrial plants having large numbers of high horsepower motors, particularly where it is important to provide clean air to keep motor maintenance at a minimum. Many plants having modest sized motors or generators could also benefit from this arrangement.

In some plants hot air, not suitable for ventilation because of its temperature, can be discharged directly to process equipment instead of to the outside. As in the case with boilers, this may also result in increased efficiency.

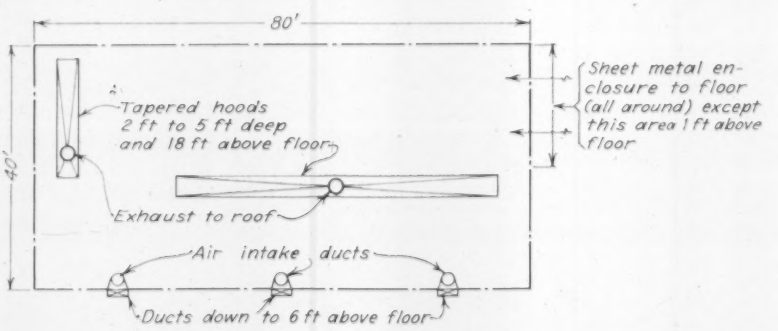
Design for Conservation of Air and Heat

Aside from the savings which may be made by heat recovery, it is also possible to reduce the heating load by careful operation of the equipment, good design of the makeup and ventilation systems, and care in designing the hoods and process equipment so as to keep makeup requirements to a minimum.

Carelessness in the design of hoods and process equipment with respect to air requirements can result in fantastic air volumes which not only require large ventilating systems but also make the problem of introducing the air into the space a formidable one. This in turn increases the boiler loads, greatly increasing the costs of this and the allied equipment and piping.

Here again if we consider that a ventilation system may cost from $0.50 to $1.25 per cfm, and that the heating equipment adds greatly to this cost, it is obvious we can make substantial savings by eliminating the excess and by designing for the actual air requirements.

7 WHERE UNTEMPERED air can be used for process or other equipment, savings are substantial. Enclosure shown here is not a working area in the ordinary sense, so employee comfort is not a problem. Of the air removed, 65 percent comes directly from outside and 35 percent comes from surrounding area through opening at bottom of one end of enclosure. In this enclosure, heat removal is effected by dilution and hood exhaust. Where there are hoods in critical areas, great care should be taken to be sure that makeup air does not disturb safe operation of hoods

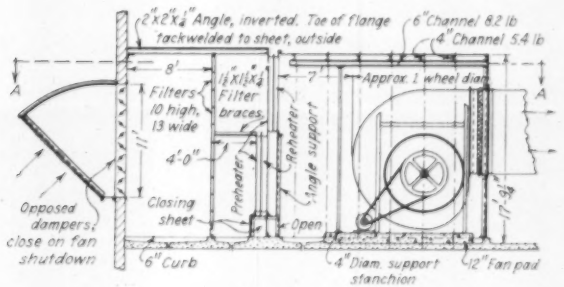

80'
40'
Tapered hoods 2 ft to 5 ft deep and 18 ft above floor
Sheet metal enclosure to floor (all around) except this area 1 ft above floor
Exhaust to roof
Air intake ducts
Ducts down to 6 ft above floor

Cost Comparison Favors Large Central Systems

EDITORS' NOTE—*In the August, September, and October issues, details were presented on the proper design of built-up industrial ventilation systems. Mr. Clarke presents here a cost comparison for a single 150,000 cfm built-up system and ten 15,000 cfm systems of the package air handling type and shows that the cost per cfm is lower for the large central system.*

There is a growing realization that considerable savings can be obtained by the use of large central systems which reduce the duplication of piping, electrical power, and maintenance. Where zoning may be required the advantage of the central system is decreased as compared to multiple units, one for each zone, because piping must be run to each zone for both types of installations. But the other duplications still exist. Not many industrial production areas require zoning such that individual units or zone heaters are necessary.

To provide an interesting comparison between a single large system and an installation of multiple small systems, the costs have been estimated and tabulated in Table 1 for a built-up system of 150,000 cfm capacity, as indicated by Fig. 1a which appeared in the October article, and ten 15,000 cfm air handling units of the packaged type.



ELEVATION

1a SYSTEM CASING DESIGN for 150,000 cfm industrial supply system for tempered, 100 percent outside air with double width, double inlet fan to operate at 2 in. static pressure shown above. Cost comparisons are tabulated for a system of this design and an installation consisting of 10 package units of 15,000 cfm each

It should be noted that there is little difference in the installed base cost, But this could vary widely, depending upon the type of installation (ceiling or floor mounting) of the small systems. Except for makeup air systems requiring little or no ductwork the small units would be at a considerable disadvantage so far as the external additions are concerned. The savings in engineering and drafting time for the one system versus the 10 small ones would be very substantial.

TABLE 1—COST COMPARISON of a single 150,000 cfm system and ten 15,000 systems of the package, air handling type is as follows

150,000 cfm System (Fig. 1a)		
System casing (including inlet hood)		$15,500
Filters		2,000
Air heaters		5,000
Controls (temperature)		1,500
Concrete work		2,300
Insulation		800
Fan		1,200
Motor (75 hp)		2,200
Motor controls		1,300
	Base cost	$32,800
External Additions		
Ductwork[1]		$30,000
Electrical work and material		1,000
Piping work and material		15,000
	Total	$78,800
Cost per cfm		$0.52
Ten package type air handling units rated 15,000 cfm each		
Units (heaters and filters)	@ $1800 each	$18,000
Installation[2] (Outside air connections, supports, and moving to site)	@ $ 200 each	2,000
Temperature controls	@ $ 600 each	6,000
7½ hp Motors	@ $ 800 each	8,000
Motor controls	@ $ 140 each	1,400
	Base cost	$31,400
External additions		
Ductwork at $3000 (assumed 1/10 of central)		$30,000
Electrical work and material[3]	@ $ 500 each	5,000
Piping and material[3]	@ $2000 each	20,000
	Total	$83,000
Cost per cfm		$0.55

[1]The cost of the ductwork will vary widely with the building requirements. Where summer relief with directional outlets is provided, the central system has a great advantage. For makeup air where little ductwork is required, the multiple units show to better advantage. The $30,000 cost has been adapted from an actual installation where the cost was isolated. For the same type of job the ductwork for the smaller units would have been considerably more expensive for the same 150,000 cfm capacity.

[2]The installation costs of the air handling units would vary widely with the type of installation, whether at the floor or at the ceiling. Outside air inlets would be required for each system. The $200 figure is about the minimum for any job. Most installations would be many times this figure.

[3]The electrical and piping installations will also vary widely with the distance from which the services must be brought. Costs will always be much higher per cfm for the smaller units than for the single large system.

Savings in heat load can be made by shutting down the equipment or recirculating the air during nights and weekends in plants where the makeup requirements for hoods or process occur only during the daytime work hours. In such cases the ventilation equipment should be designed for recirculation by means of a convenient switchover. However, in laboratories where continuous research projects may be in progress it is safer to keep the systems in continuous operation. In large storage spaces or similar areas having widely separated work areas it is not necessary in many instances to heat the entire building for comfort. Spot heating at the small work areas or stations can provide satisfactory working conditions at a great saving in heat load.

Where the temperature of the air is not a factor, outside air may be introduced directly to process equipment or to hooded areas. An example of this is shown by Fig. 7. In this case outside air (about 65 percent of the re-

quired exhaust) is led directly to the enclosure. To keep the enclosure under a negative pressure, about 35 percent of the air is drawn from the adjacent area through a 1 ft high opening at the bottom of one side of the enclosure. The large quantity of outside air introduced in this manner imposes neither an air nor a heat load on the main building area.

Savings on makeup air requirements can be made by providing enclosure type hoods which give excellent control with a minimum of air. The production requirements may not make them practical in many cases, but this should be carefully checked before reverting to an open design that may require three to four times the exhaust volume. Likewise, process equipment should be checked.

All too often the air quantities are set on the basis of doubling the estimated requirements "just to be sure." The cost and air handling problems of makeup air in the modern industrial plant make such an attitude expensive and unrealistic. Where there are questions as to the proper volumes required, it may be worthwhile to determine the correct volumes by experiment or pilot models. When designing hoods, an experienced industrial ventilation or industrial hygiene engineer should be consulted.

In designing heat recovery systems, particular attention should be paid to the year 'round building balance, building codes, and fire protection requirements.

The desirability of installing heat recovery or conservation systems for new or existing buildings and systems will depend upon the grouping of the building areas and systems, the cost of the recovery installation, and the return which may be realized on the investment. Some systems will cost as little or possibly less than conventional supply systems. Others will be too expensive or too impractical to make the installation worthwhile. Only by a careful study of the individual problem and equipment is it possible to determine which will be the case.

Acknowledgments

The writer wishes to acknowledge the review of these articles on industrial ventilation and the helpful comments provided by several of the engineers of the manufacturers of various types of heating and ventilating equipment. In addition, the constructive criticisms and suggestions of the following have been of considerable help in the effort to make these articles as authentic and as helpful as possible: J. C. Barrett, ventilation engineer, Michigan Dept. of Health; K. E. Robinson, ventilation engineer, research staff, General Motors Corp.; B. R. Small, staff ventilation engineer, Aluminum Co. of America; and F. J. Hosticka, electrical engineer, Visking Co., Div. of Union Carbide Corp. ⫩

Unusual Ductwork, Piping Follow Round Contour of Control Tower

. . . structure to have 100 tons of air conditioning

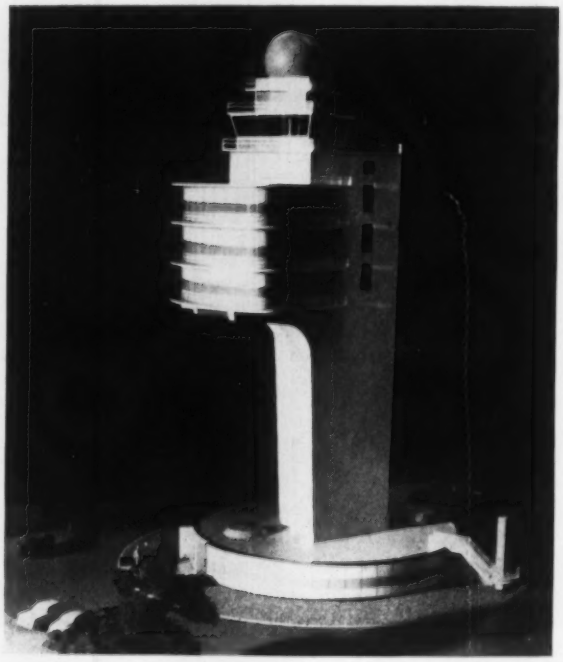
A CONTRACT to install air conditioning, heating, and ventilating equipment for the new $1,750,000 control tower at Newark Airport has been awarded to Hudik-Ross Co., Inc., mechanical (heating, piping, and air conditioning) contractor.

The 150 ft concrete tower now under construction by the Port of New York Authority, will incorporate some of the most advanced design and equipment features yet devised for an airport control tower.

The air conditioning facilities in the tower will serve a dual purpose. In addition to supplying comfort cooling for the Civil Aeronautics Administration personnel who control all air traffic at the airport, the system is designed to provide constant temperatures that will insure accurate operation of delicate electronic, radar, and weather equipment the year 'round. The high velocity system with centrifugal compressor will have a 100 ton cooling capacity.

An unusual feature of the system will be the shape of the ductwork and piping which will follow the generally round contours of the uniquely designed building. The first floor of the tower, where the cooling equipment will be housed, will be circular in shape, with a diameter of 78 ft. The cooling tower, completely hidden by the design of the structure, will be located on the first floor roof.

A. Gordon Lorimer, architect, designed the tower, and Slocum & Fuller are the consulting engineers. ⫩



NEWARK AIRPORT control tower, depicted in architects model, will feature unique structural design, year 'round air conditioning

The Law and Your Profits

BY WILLIAM HURD HILLYER

Subcontractor Stung by *Valid* Contract

IF A subcontractor receives a purchase order from a general contractor and, failing to sign it, proceeds with the work on the theory that the lack of his signature keeps it from being a contract, he can find himself the big loser. The subcontractor in the following case found this out.

Hevibild Bros. were general contractors for the construction of a generating plant. They invited subcontractor bids on piping, heating, and air conditioning. E. Quipp, Inc. submitted a figure of $70,000 to cover all three categories. Subsequent telephone conversations between Quipp and Hevibild resulted in Quipp making a revised bid of $40,000 under the impression that air conditioning would be omitted from the new contract.

In court Hevibild's version of the talk was that air conditioning was still included and that the reduced figure resulted from certain omissions and changes in the other work.

Before Quipp started performance on his subcontract, Hevibild sent him a written "purchase order" which included "air conditioning" in bold type and stated the agreed (reduced) contract price. Quipp received this order, without which he was not authorized to start work. However, that concern's officials claimed that they had not seen it, nor did they understand it as including air conditioning. Manifestly, they did not sign it so as to make it a *written* contract.

Quipp sent Hevibild a number of "progress reports" in the course of the work. These reports referred to piping and heating only, without mention of air conditioning. When the piping and heating work was finished, Quipp demanded the balance of the contract price. Hevibild refused to pay because the air conditioning had not been installed. Quipp brought suit. Meanwhile, Hevibild spent $7000 to have the air conditioning work done by another firm.

Plaintiff Quipp contended in court that, due to telephone misunderstanding, the minds of parties "never did meet on the scope of the work to be performed" and, consequently, "there was no express contract."

He claimed his right to the subcontract price for the piping and heating on the *quantum meruit* theory—to wit, that the contract price was reasonable for these two services.

From the circuit court's decision against E. Quipp, Inc., that firm appealed. The state court of appeals affirmed the lower court's decision, reasoning substantially as follows: Quipp's position is unsound in assuming that no contract existed simply because he had a version of the agreement differing from that of defendant Hevibild. "An express agreement may be proved by direct evidence, circumstantial evidence, or both . . . Here we have both types of proof."

In support of direct evidence, the higher court averred, "We have the 'purchase order' sent by defendant to plaintiff. It specifically referred to air conditioning work. Since this order authorized Quipp to proceed, and he did so on the basis thereof, he can be held to have assented to its terms.

"The fact that 'progress reports' did not mention air conditioning could not change the contract. They merely show work completed by plaintiff. It does not appear that the air conditioning work must have been carried on at the same time as the piping and heating."

The judges were positive in pointing out that "the parties had actually negotiated about air conditioning work. A witness for the defendant testified that the last bid included it. Furthermore, the purchase order specifically referred to air conditioning work. Quipp should have taken notice of its contents. The trial court could have determined that the plaintiff did have such knowledge."

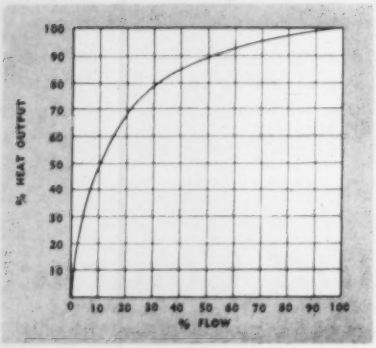
In respect to a counter-claim filed by the prime contractor for unperformed work allegedly covered by contract price, the higher tribunal held that this "really involved an accounting."

Citing authorities, the court of appeals affirmed the lower court's decision against the subcontractor, including the allowance of a $7000 offset to pay for the air conditioning installation by another firm.

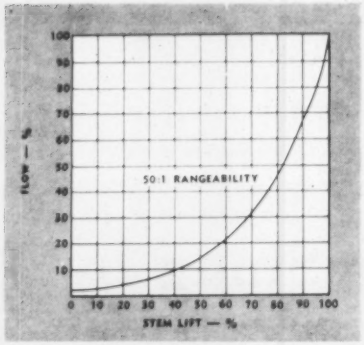
To borrow from legal jargon—*res ipsa loquitur*—this case speaks for itself. Subcontractor Quipp was clearly negligent in trusting a telephone conversation as a basis for a $30,000 bid reduction, in accepting a purchase order apparently without looking at it, and in sending ambiguous progress reports to general contractor Hevibild. As a result, Quipp was a substantial loser. ⌗

WILLIAM HURD HILLYER, *author of this regular feature, is a contributor to a number of banking and financial publications and has written several books on business. He has an extensive practical legal and financial background.*

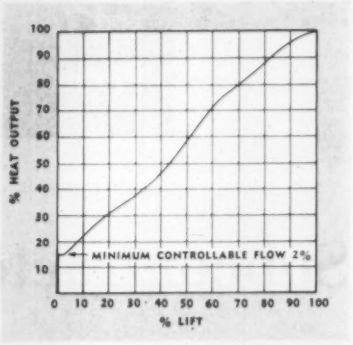
This series presents actual cases. All names are, however, fictitious. It should, of course, be remembered that laws vary in different states.



1 WHEN WATER FLOW through a heating coil is reduced, heat output of that coil follows this steep curve. Chart is for coil designed for 200 F and 20 F drop



2 EQUAL PERCENTAGE valve meets requirement of providing flow characteristics to match steep coil curve shown in Fig. 1



3 IF EQUAL PERCENTAGE valve is applied to coil so that pressure drop across valve is reasonable percentage of coil pressure drop and upstream pressure remains constant, heat output and valve position will have this relationship

What to Look For in a Valve For Hot Water Heating Control

If a control valve is to provide good proportioning control of the heat output of a hot water coil, it must have two features:

- **Equal percentage flow characteristics to match the steepness of the coil curve**
- **High rangeability (ratio of maximum flow to minimum controllable flow) to control the flow at the very small percentage of maximum design that is necessary to limit the coil heat output below 10 percent.**

Both features are important. But by far the more important is high rangeability. Without it, equal percentage throttling plugs are of little value. High system turn-down ratio requires not only a well made valve, but also a carefully chosen one. Selecting a valve with less that 50 percent pressure drop at the design flow does not allow effective use of the high rangeability feature of the valve.

BY W. G. YOUNG
Manager of Product Engineering
Automatic Controls Div.
Barber-Colman Co.

WHEN the flow of water through a heating coil is reduced, the heat output of that coil follows a curve similar to that shown in Fig. 1. Such a steep curve puts a heavy burden on any valve whose job it is to proportion heat output. To be effective, such a valve must (1) be designed to meet this steep coil curve, and (2) be able to reduce the flow to only a small percentage of design maximum.

The equal percentage flow characteristic shown in Fig. 2 does a satisfactory job of meeting the first requirement. When an equal percentage valve is applied to a coil so that the pressure drop across the valve is a reasonable percentage of the coil pressure drop (50 percent drop for the valve) and the upstream pressure remains constant (regulation across the pump or a reasonably flat pump curve), then the heat output *vs* valve position will appear as in Fig. 3.

While the equal percentage valve fulfills the need for ample characterization, it does not necessarily provide for controllability near the closed end of the stroke. This requirement is not related to the shape of the throttling plug, but rather to the

clearance between the plug and seat, as illustrated in Fig. 4.

It is sometimes thought that simply because a valve closes tight it can control flow between maximum and zero. Such is not the case. A point is reached where the effective area no longer decreases as the valve closes. This ratio of maximum flow to minimum controllable flow is known as the *rangeability* of the valve.

For example, if a valve could pass 100 gpm (with a pressure drop of 5 psi) and had a rangeability of 20 to 1, the minimum controllable flow would be 5 gpm (if the pressure drop were constant). Lowering the stem below this point would not further reduce the flow until the valve shuts off altogether.

What Affects Rangeability?

The determining factor affecting a valve's rangeability is the clearance that can be held between the plug and the valve seat. This clearance is affected by:

1) The temperature range over which the valve must operate. If the plug fits too closely, unequal expansion of the matching parts may cause binding.

2) Installation techniques may distort the valve seat enough to cause the plug to stick.

3) Manufacturing tolerances that can be held in competitively priced equipment.

4) Foreign matter flowing in the lines may get wedged between plug and seat, causing the plug to stick.

In the past, clearance between plug and seat ranged generally between 0.01 to 0.025 in. difference in the two diameters. A clearance of 0.010 in. on a 1 in. diam valve results in an area reduction of about 50 to 1. The same clearance on a ½ in. valve would result in a reduction of only 25 to 1 (minimum flow 4 percent of maximum). With the trend toward individual room control where zones are broken into smaller areas requiring smaller valves, rangeability has become an all important factor.

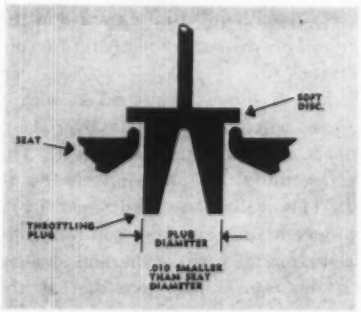
It has gained still more importance with the increased use of hot water as a heating medium. With steam, heat output is directly proportional to flow. But with water, 4 percent flow results in about 23 percent heat output. The resultant system rangeability would be only 3.5 to 1.

Outdoor reset on the hot water source helps relieve this situation—especially during colder weather. The use of direct radiation on the same heat source limits the reduction in water temperature during milder weather.

What Is Rangeability Value?

Rangeability of a valve when applied to a system is often less than the theoretical value. For example, if the required design flow were 10 gpm, but the selected control valve passed 20 gpm when wide open, the minimum controllable flow (assuming a 20 to 1 rangeability) would be 1 gpm. However, design flow is only 10 gpm. So the system rangeability would be only 10 gpm, divided by 1 gpm, or only 10 to 1. Because the valve was twice too large to start with, its rangeability when applied to the system has been cut in half. The useful rangeability of the valve, when applied to the system, is called *turn-down ratio.*

Factory ratings as applied to rangeability are based on a constant pressure drop across the valve at all times. As valves close off, decreasing the flow of water within the system, the pressure loss in the supply mains decreases also. In addition, the circulating pump has a regulation curve



4 CONTROLLING of flow to only a small percentage of design maximum, near closed end of stroke, is related to clearance between valve's plug and seat

such that, as the flow decreases, the pressure output of the pump increases, as shown in Fig. 5. Both of these factors tend to increase the pressure drop across the valve as it reaches the minimum controllable flow.

If the pressure drop across the valve quadruples, the minimum controllable flow will increase by a factor of 2, thus cutting the turn-down ratio in half. For example, a ½ in. valve will pass 9 gpm with a 5 psi pressure drop when the stem is up. With a 20 to 1 rangeability, the minimum controllable flow will be 0.45 gpm. If the regulation of the pump, coupled with the decrease in pressure loss of the supply main, caused the pressure across the valve to increase to 20 psi, the minimum controllable flow would be 0.9 gpm. The turn-down ratio would then be only 10 to 1.

How About Pressure Drop?

Poor relationship of pressure drop across the valve to the pressure drop across the control device (such as a coil in a fan coil unit) has the same adverse effect as poor pump regulation. For instance, if the pressure drop across a ½ in. valve were 1 psi with 4 gpm flowing and the loss in the coil at 4 gpm were 9 psi (often referred to as a 10 percent drop), the effect would be that the total pressure of the supply mains would appear across the valve when it closes. This means that the pressure drop would increase from 1 psi when the valve is open, to 10 psi when it is closed.

As the pressure drop increases, the turn-down ratio decreases. If the rangeability were 20 to 1 at a constant drop of 1 psi, the turn-down ratio of the valve, as applied to the coil, would be about 7 to 1 as the pressure drop approaches 10 psi. Since approximately 15 percent of the flow to a hot water coil results in about 60 percent of the coil heat output, the turn-down ratio of the system is less than 2 to 1. If the allowable pressure drop across the control valve were 50 percent at full flow instead of 10 percent, the turn-down ratio of the valve, as applied to the coil, would be increased to about 14 to 1.

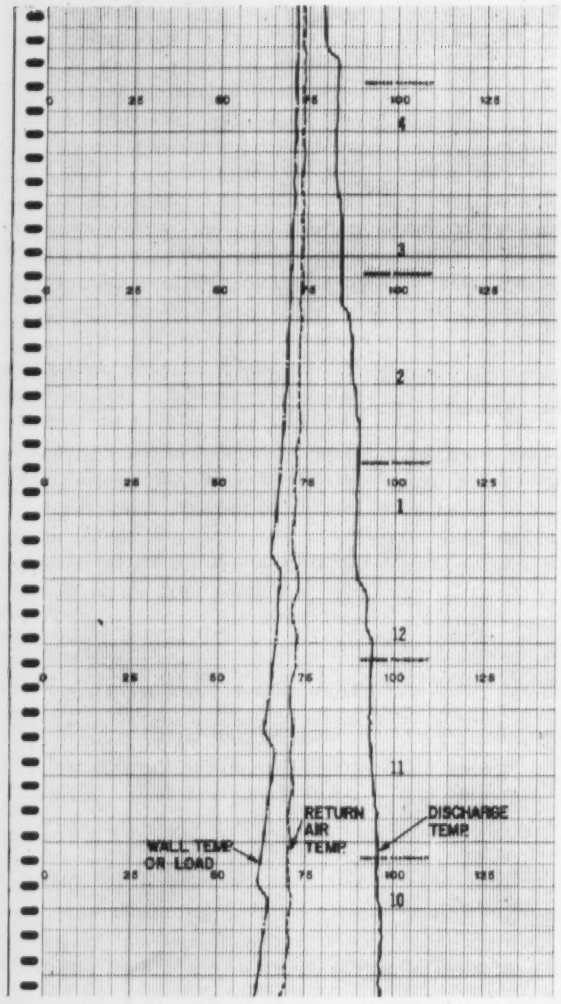


Fig. 5

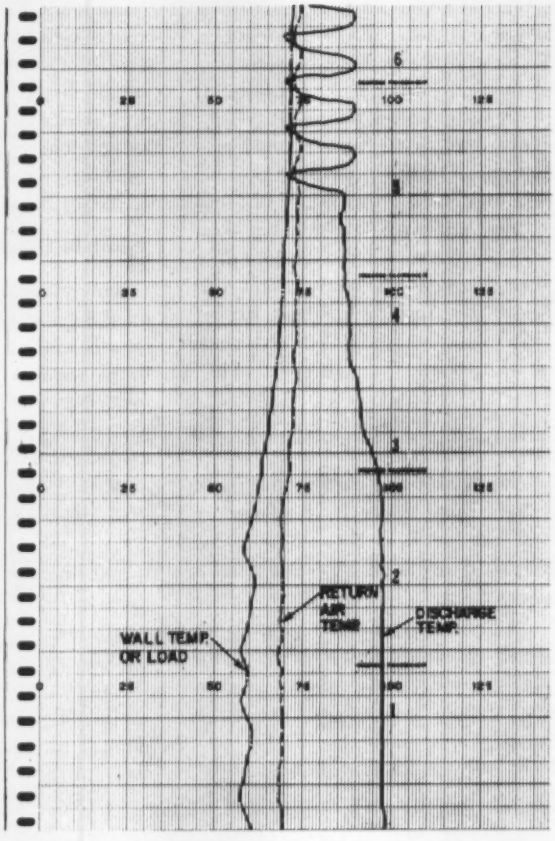


Fig. 6

5-6 IMPORTANCE OF HIGH TURN-DOWN RATIO is shown on these recorder charts. Load on induction unit was varied from maximum to minimum and resultant discharge temperature observed. Fig. 5 is record of ½ in. proportioning valve with high rangeability (plug clearance of 0.003 in.); Fig. 6 represents same sized valve with low rangeability (plug clearance of 0.006 in.)

and the lesser minimum flow would improve the turn-down ratio of the system.

Valve Clearance Important, Too

To make a valve that will effectively throttle the heat output of a hot water coil, the clearance between seat and plug diameters must be held to a minimum for a rangeability of 75 to 1 or better.

The two recorder charts shown in Figs. 5 and 6 illustrate the importance of high turn-down ratio. These charts were made on an induction unit set up in a laboratory where the load could be varied from maximum to minimum and the resultant discharge temperature observed.

Fig. 5 shows results taken with a ½ in. valve having a 0.003 in. clearance between plug and seat. The rangeability is approximately 84 to 1. This valve was positioned by a proportioning operator controlled by a thermostat with its thermal element in the return air. Note that as the load is decreased (denoted by the wall temperature rising), the discharge temperature gradually lowers to compensate.

Fig. 6 illustrates an almost duplicate test. The only difference is that the throttling plug was first removed from the valve and an additional 0.003 in. was ground off the diameter (rangeability about 42 to 1), making the clearance 0.006 in. instead of the original 0.003. Note how the discharge temperature follows the reduction in load until a point is reached where lowering the valve stem no longer reduces the flow. The valve then goes into a cycling condition, regulating the discharge by closing off tight and then reopening in an "on-off" manner. ∓

Pipe Welding Terms Defined

BY HELMUT THIELSCH
Metallurgical Engineer
Industrial Piping Div.
Grinnell Co., Inc.

Annealing: A process involving heating and cooling, usually applied to induce softening.

Arc welding: A group of welding processes wherein coalescence is produced by heating with an electric arc or arcs, with or without the use of filler metal.

Automatic welding: Welding with equipment which performs the entire welding operation without constant observation and adjustment of the controls by an operator. The equipment may or may not perform the loading and unloading of the work.

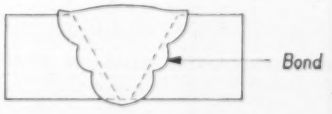
Backing ring: Weld joint backup in the form of a ring used in the welding of piping.

Base metal (parent metal): The metal to be welded or cut.

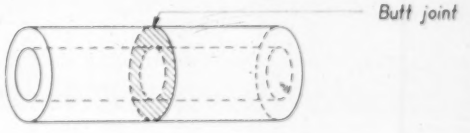
Bevel: A type of end (or edge) preparation.

Bevel angle: The angle formed between the prepared edge of a member and a plane perpendicular to the surface of the member.

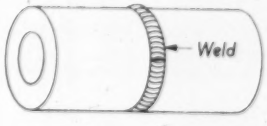
Bond: The junction of the weld metal and the base metal, or the junction of the base metal parts when weld metal is not present.



Butt joint: A joint between two members lying in approximately the same plane.



Butt weld: A weld in a butt joint.



Chamfering: The preparation of a contour, other than for a square groove weld, on the edge of a member for welding.

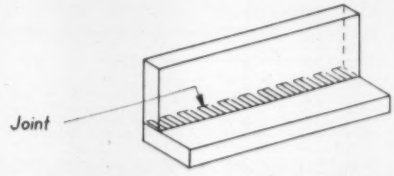
Tear out along this line

HPAC DATA SHEET

Cold working: Deformation of a metal plastically. Although ordinarily done at room temperature, cold working may be done at a temperature and rate at which strain hardening occurs. Bending of steel piping at 1300 F would be considered as cold working operation.

Controlled cooling: A process of cooling from an elevated temperature in a predetermined manner to avoid hardening, cracking, or internal damage, or to produce a desired metallurgical microstructure. This cooling usually follows the final hot forming or postheating operation.

Corner joint: A joint between two members located approximately at right angles to each other in the form of an "L."

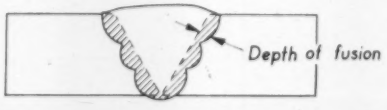


Covered electrode: A filler metal electrode, used in arc welding, consisting of a metal core wire with a relatively thick covering which provides protection for the molten metal from the atmosphere, improves the properties of the weld metal, and stabilizes the arc. Covered electrodes are extensively used in the shop fabrication and field erection of piping of carbon, alloy, and stainless steels.

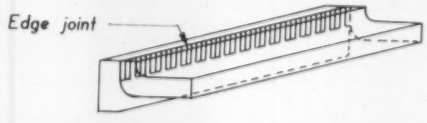
Cutting torch: A device used in oxygen cutting for controlling and directing the gases used for preheating and the oxygen used for cutting the metal.

Deposited metal: Filler metal that has been added during a welding operation.

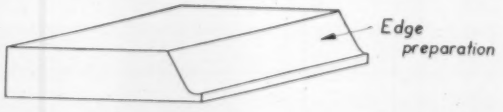
Depth of fusion: The distance that fusion extends into the base metal from the surface melted during welding.



Edge joint: A joint between the edges of two or more parallel or nearly parallel members.



Edge preparation: The contour prepared on the edge of a member for welding. See also **End preparation.**

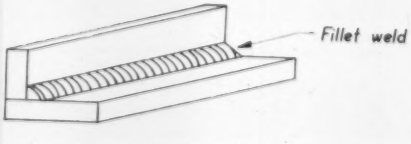


Electrode: See **Covered electrode.**

End preparation: The contour prepared on the end of piping for welding.

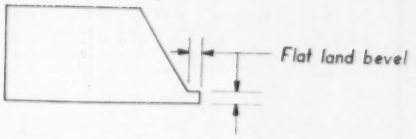
Filler metal: Metal to be added in making a weld.

Fillet weld: A weld of approximately triangular cross section joining two surfaces at about right angles to each other in a lap joint, tee joint, or corner joint.

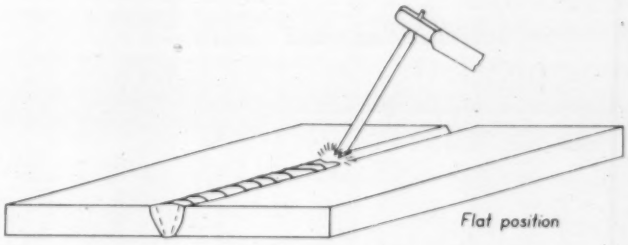


Tear out along this line

Flat land bevel: A square extended root face preparation extensively used in inert-gas, root-pass welding of piping.



Flat position: The position of welding wherein welding is performed from the upper side of the joint and the face of the weld is approximately horizontal.

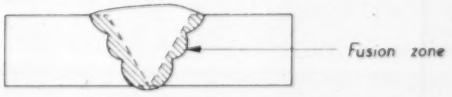


Full annealing: A softening process in which carbon and alloy steel is heated to a temperature above the transformation range and, after being held for a sufficient time at this temperature, is cooled slowly to a temperature below the transformation range. Ordinarily cooling is done in the furnace.

Full-furnace annealing: Full annealing of a complete steel section, such as a fabricated piping assembly done in a furnace.

Fusion: The melting together of filler metal and base metal, or of base metal only, which results in coalescence. See **Depth of fusion.**

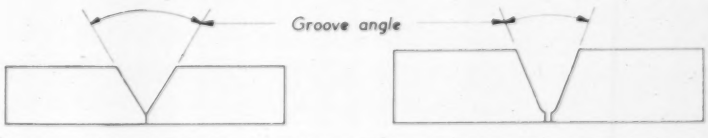
Fusion zone: The area of base metal melted as determined on the cross-section of a weld.



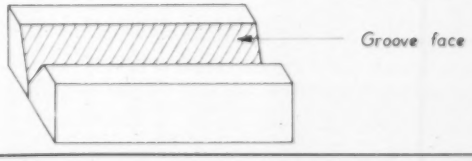
Gas welding: A group of welding processes wherein coalescence is produced by heating with a gas flame or flames, with or without the use of filler metal.

Groove: The opening provided for a groove weld.

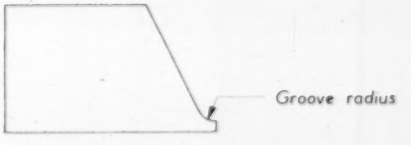
Groove angle: The total included angle of the groove between parts to be joined by a groove weld.



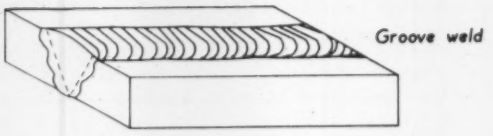
Groove face: That surface of a member included in the groove.



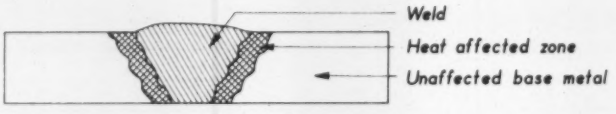
Groove radius: The radius of a J- or U-groove.



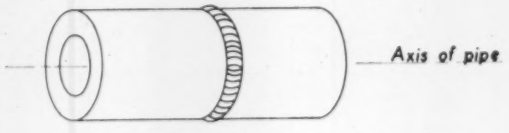
Groove weld: A weld made in the groove between two members to be joined. The standard types of groove welds are as follows: square groove weld; single v-groove weld; single bevel groove weld; single u-groove weld; single j-groove weld; double v-groove weld; double bevel groove weld; double u-groove weld, and double j-groove weld, and flat land single and double v-groove welds.



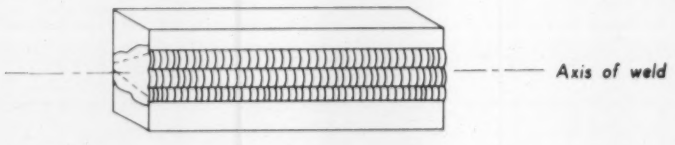
Heat-affected zone: That portion of the base metal which has not been melted, but whose mechanical properties or microstructures have been altered by the heat of welding or cutting.



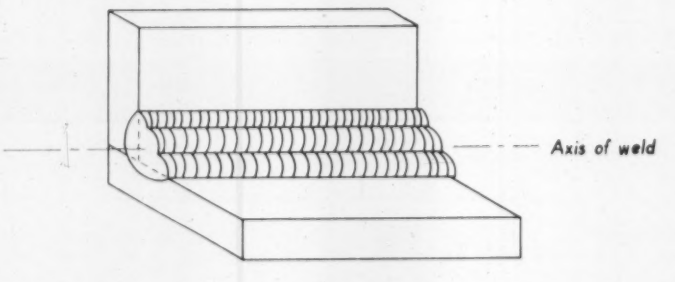
Horizontal fixed position: In pipe welding, the position of a pipe joint wherein the axis of the pipe is approximately horizontal and the pipe is not rotated during welding.



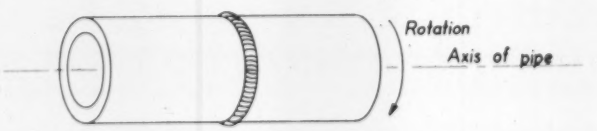
Horizontal position: Groove weld—The position of welding wherein the axis of the weld lies in an approximately horizontal plane and the face of the weld lies in an approximately vertical plane.



Horizontal position: Fillet weld. The position of welding wherein welding is performed on the upper side of an approximately horizontal surface and against an approximately vertical surface.



Horizontal rolled position: Pipe welding. The position of a pipe joint wherein welding is performed in the flat position by rotating the pipe.



Hot working: Plastic deformation of metal at such a temperature and rate that strain hardening does not occur. Extruding or swaging of chrome-moly piping at temperatures between 2000° and 1600 F would be considered hot forming operations.

More pipe welding terms will be defined and illustrated in early issues. ‡

HEATING, PIPING & AIR CONDITIONING

JOURNAL SECTION

OF

AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS

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President's Message

Society Autumn Activities

November is the last month for discussion of the merger plan with *ASRE*. The plan in its final form is the result of months of meetings and discussions by committee members and by your Officers and the Council. All chapters have been urged to devote program time to the subject and many have done so. Every effort has been made to get the essential information concerning the plan into the hands of members of the Society. Mail ballots for use in proxy voting were distributed in October and the proxies will vote at the Special Meeting, December 1st, in Chicago. The Officers and the Council again urge that every eligible member exercise his voting right either by authorizing a proxy vote or by attending the Special Meeting and voting in person.

October of each year is marked as the time when many Society activities get into full swing. At the Headquarters office, budgets have to be considered and worked out; the Annual Meeting program needs completion and approval; membership programs are vitalized; the annual edition of THE GUIDE is made ready for printing; committees meet and plan their activities. Only a few of the chapters meet throughout the summer months, but all have their programs under way by October. In short, just about every function of the Society is making progress at this season.

During October too, I had the pleasure on the 15th of presenting a charter to our new San Diego Chapter in California, which is the 73rd local group to be organized. Also on the 20th, I had the pleasure of attending a special fall meeting of chapters of Region 6 in Fort Worth, Texas. In between these two dates, there was a Council meeting at Las Vegas.

This matter of my travel during October brings to mind the point that the new regional plan makes it possible for the President to have personal contact with representatives of every chapter of the Society by attending the meetings of the Regional Chapters Committees. During the year, I was privileged to attend all these meetings. I can report that this was a source both of personal pleasure and inspiration, and also that it offers an opportunity for the President to feel that he is in touch with chapter needs and chapter thinking. So also being present at the charter meetings of the two new chapters, at Calgary last spring and at San Diego during October, gave me a feeling of being in touch with Society expansion in a very real sense. These experiences also tend to confirm the feeling that the Society is a live and moving force in the affairs of its members, and renders a real service to our profession and to the public.

E. R. Queer

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Assistant Editor

Information on other Society personnel can be found on page 172

Pulsations in Single-Port Gas-Fired Residential Heating Equipment

By C. F. Speich* and A. A. Putnam**, Columbus, Ohio

This paper is the result of research sponsored jointly by the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, the *American Gas Association* and the *Oil Heat Institute of America*, conducted through Battelle Memorial Institute.

SUMMARY—This report summarizes the results of research conducted on combustion oscillations in gas-fired single-port heating units. This work was accomplished as part of a four-year program on a fundamental study of pulsations and oscillations in gas- and oil-fired heating equipment. The mechanism of oscillations for single-port gas units was found to consist of a vortex-shedding phenomenon at the burner lip coupled with a pressure fluctuation in the heating unit. The natural frequency of the vortex shedding was found to be a function of the average velocity of the combustible gas stream, whereas the frequency of the pressure fluctuations in the heating unit is determined by the resonant frequency of the furnace or boiler. It is the degree of the coupling between these two frequencies when they are together which determines the amplitude of oscillation. Applying the knowledge of the details of the driving mechanism, it is possible to devise more basic means of suppressing oscillations in these units.

PULSATIONS in heating equipment have plagued manufacturers and users for many years. The suppression or elimination of these pulsations has led to the evolution of a large number of suppression techniques. Unfortunately, no one technique seems to be adaptable to all pulsation problems. While users were becoming more noise conscious, the entire problem has been aggravated by the trend toward placing smaller, tighter heating units nearer the living areas of the residence. Need has therefore arisen to find the basic causes of the pulsations and thereby obtain better ways of *curing* the oscillations. To implement this search for the basic causes of pulsation, a research program was initiated at Battelle in May, 1954, to (1) determine the basic mechanism of oscillation in both gas- and oil-fired heating units, and (2) determine means of suppressing or eliminating these oscillations or pulsations. During the 4 years of this program, studies have been made of oscillations in gas-fired multiple-port, gas-fired single-port, and oil-fired heating units. Numerous investigations of all 3 types of units have been made both in the field and in the Battelle laboratories. During this time, many different variables or parameters have been studied to determine what effect each had on the oscillations or pulsations of the units. From these studies, the basic mechanism for the oscillations in each of these units has been postulated.

This is the fourth in a series of papers presenting the findings of this project[1,2,3]. The purpose of this paper is to outline the basic mechanism of oscillation for single-port gas-fired heating units. Included are the findings leading up to the postulation of the mechanism, a description of the mechanism from a macroscopic viewpoint, and additional data which appear to confirm this mechanism. As a preface to a succeeding paper, the application of this mechanism to the suppression of single-port gas flame oscillations is discussed briefly.

Terminology

To aid in discussing the theroretical considerations and the results of the tests, a number of acoustical terms will be defined.

Fig. 1 shows the sinusoidal variations of pressure with time and space, and those terms which may be clarified by illustration are shown on the figure.

1. *Oscillation*: periodic variation, with time, of pressure with respect to the ambient pressure. During oscillation, the pressure is alternately greater than and less than the ambient pressure.

2. *Pulsation*: here considered to be the observable effects of the pressure oscillations. That is, pulsations can be seen, felt, or heard by an observer, or measured as changes in pressure of the surrounding atmosphere or as forces exerted on surrounding surfaces. Since there are certain physiological implications connected with the term pulsation, the more precise term oscillation is used in the subsequent discussion.

3. *Surge* (also called burst, thrust, thump): the amplitude of oscillation usually varies with time; the *surges* of high amplitude often occur about one to five times a second. The ear hears these surges as variations in noise or pulsation amplitude. The surges may be accompanied by a change in overall pressure level in the heating unit. This results in blasts of air pressure which can rattle loose parts and even loosen objects in the furnace room.

4. *Cycle*: complete sequence of values of pressure; at the end of a cycle, the pressure, the rate of change of pressure, and the direction of change of pressure have the same values that they did at the start.

5. *Period*: time interval corresponding to one cycle.

* Principal Mechanical Engineer, Battelle Memorial Institute.

** Assistant Division Chief, Battelle Memorial Institute.

For presentation at the 65th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, Philadelphia, Pa., January 1959.

[1]Exponent numerals refer to References.

6. *Frequency*: number of periods occurring in one second or number of cycles per second (cps).

7. *Amplitude*: absolute value of the maximum difference between the instantaneous static pressure and the ambient pressure in a given period. The variations in the instantaneous static pressure can be with respect to time or space and the value of the amplitude need not be the same for both.

8. *Phase*: fractional part of a period through which the independent variable, usually time, has advanced, measured from an arbitrary origin. The origin is usually chosen so that the fraction is less than one.

9. *Wavelength*: distance between 2 wave fronts in which the pressures have a difference in phase of one complete period. During one period, the wave has advanced a distance equal to the product of the velocity of sound by the period.

10. *Mode Number*: the mode number is equal to the number of half wavelengths along a given dimension for a given system. The fundamental mode of a simple system represents the situation where the mode number for the system is equal to one for each dimension under consideration.

11. *Standing Wave*: oscillations having a fixed distribution of amplitudes in space, and characterized by the existence of nodes and antinodes that are fixed in space. In the fundamental mode of a heating unit, the acoustic pressures at all points are in phase.

12. *Nodes*: locations in a standing wave where the instantaneous pressure is equal to the ambient pressure during a given period.

13. *Antinodes*: locations in a standing wave where the instantaneous static pressure is equal to the amplitude during a given period.

14. *Natural Frequency*: the frequency at which a system will tend to oscillate when disturbed. The natural acoustic frequency of an enclosed space is a function of the configuration and volume of the space.

15. *Resonance*: for this discussion, resonance can be considered to be a condition in a system where the frequency of a periodic driving force on the system is equal to the natural frequency of the system. The effect of resonance is to cause oscillations of large magnitude in the system and to allow coupling for maximum energy transfer to take place between the system and the driving force.

16. *Resonant Frequency*: the frequency of the periodic driving force which causes a system to resonate.

17. *Normal Frequency*: for this discussion, normal frequency denotes the frequency of vortex shedding from the lip of the burner tube when the burner is external to the furnace.

18. *Helmholtz Frequency*: a resonant frequency of an enclosure made up of one or more nearly closed volumes, and one or more openings or connections of small cross-sectional area. The magnitude of this frequency is dependent upon the shape of the system and the mode of oscillation.

19. *Helmholtz-type Oscillation*: an oscillation occuring within an enclosure at or near the Helmholtz frequency.

20. *Damping*: the attenuation of the amplitude of oscillation which results from frictional and acoustical radiation effects in the system.

21. *Coupling*: an interaction between systems. In this paper, the interaction is between the vortex shedding and the pressure oscillation in the heating unit. When there is little interaction, the coupling is said to be low or *loose;* when there is large interaction, the coupling is said to be high or *tight.*

22. *Percent Primary Theoretical Air*: the weight ratio, multiplied by 100 of the actual primary air flow to the minimum

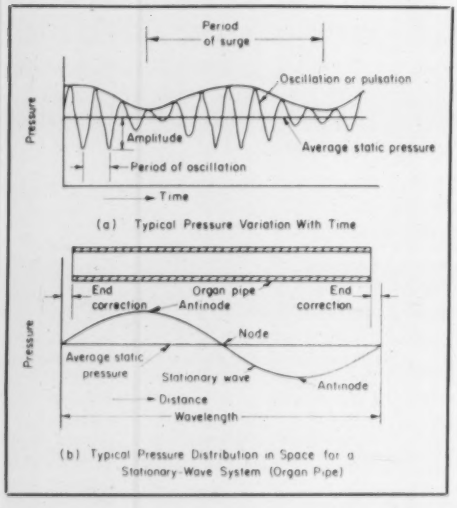

Fig. 1 *(left)* — Pressure variation in an oscillating gaseous system

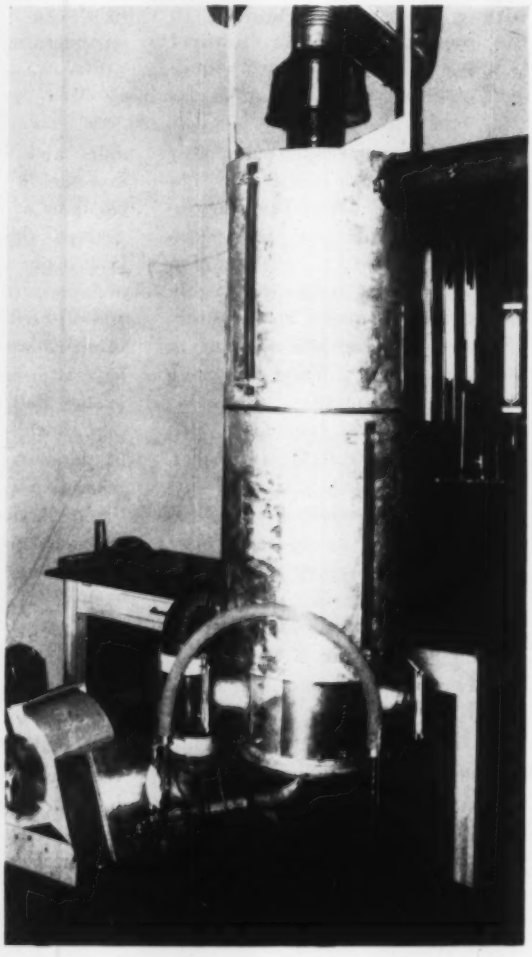

Fig. 2 — Experimental gas-fired furnace for oscillation studies

air flow needed for theoretical complete combustion. For all of the investigations of single-port burners during this project, natural gas was used as the fuel. Upon the advice of the Pulsation Research Steering Committee, the stoichiometric air-fuel ratio for natural gas was taken to be 9.8 to 1.

Initial Investigations

As a starting phase, trips were made into the field and to laboratories of various manufacturers of residential gas-heating units. By investigating a number of different units, it was determined that the frequency range of the oscillations occurring in heating units fired with single-port gas burners was between 40 and 80 cps,[1,2] and were of the standing-wave type. In addition to these field studies, a conventional type of single-port gas unit with a drum-type heat exchanger was investigated more extensively in the laboratory. These additional studies confirmed the field test results that the oscillations were of the standing-wave type. The experience of manufacturers and members of the Pulsation Research Steering Committee, plus the results of these studies, indicated that there were a number of variables which could have some effect on the amplitude of oscillation produced by the heating unit.

Fig. 2 shows the experimental single-port gas furnace constructed to permit the more complete investigation of the effect of various parameter changes on oscillations. This furnace was free from internal complexities. All of the factors investigated and the results obtained are presented in detail in Appendix B and C†. Of the variables investigated, only the rate of primary air flow had any large effect on the amplitude of oscillation. Other variables such as the secondary air opening, which controls the rate of secondary air flow, were found to have a small effect on the amplitude of oscillation. This effect was later attributed to changes in the acoustic system whereby both the resonant frequency of the furnace and the position of the pressure antinode inside the furnace were controlled partially by the secondary-air opening. If changing the size of this opening caused the pressure antinode to approach the flame, then an increase in the amplitude of oscillation would be noticed. However, this change in amplitude was not nearly as large as that experienced with changes in primary-air flow.

A change in the length of the burner tube was also found to affect the amplitude of oscillation. This effect will be discussed subsequently in greater detail.

Other parameters such as spreader diameter, spreader height, and position of the burner in the furnace were found to have little or no effect on the amplitude of oscillations.

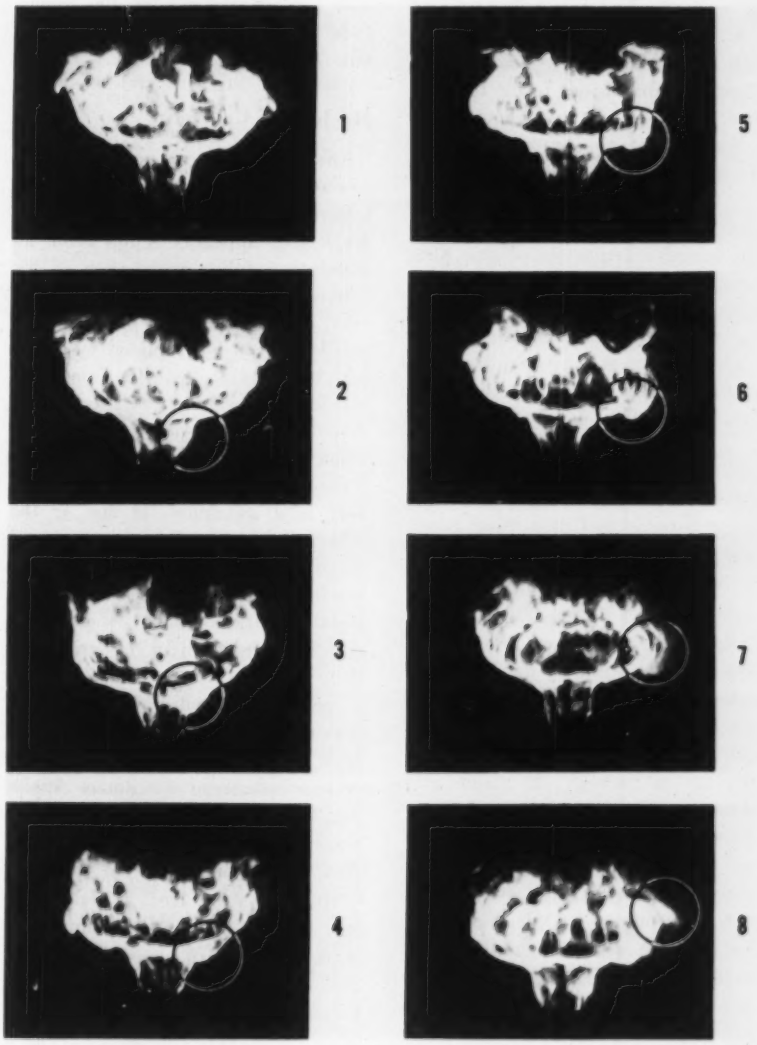

Fig. 3 — Sequence of high-speed photographs showing the shedding of vortices from a single-port burner external to the furnace (58 percent primary theoretical air)

†It is planned to publish the Appendices with the paper in the TRANSACTIONS.

Since changes in primary air-flow rate caused the only large change in the amplitude of oscillations, it became apparent that the mechanism of oscillation was concerned with events which occurred at the burner lip or in the burner tube.

At the beginning of these studies, high-speed movies were taken of the flame with the burner inside the furnace. Analysis of these photographs indicated that there were periodic disturbances in the flame which had the appearances of vortices being shed from the lip of the burner tube. Photographic sequences of this phenomenon were shown in the first report of this series[1]. The indication that vortex shedding from the burner might be present was considered an important step in finding the basic mechanism of oscillation. Therefore, additional high-speed movies were taken. These movies were taken of the flame with the burner external to the furnace and in a large room, in order to eliminate the effect of the furnace as a variable.

Fig. 3 shows a typical photographic sequence of the vortex shedding under the condition of the burner in a large room. These vortices indicated by the circles on photographs 2 through 8, appear like smoke rings passing up through the flame and causing undulations along the envelope of the flame. Different air and fuel-gas flow rates used to determine to what degree the frequency of the vortex shedding was dependent on the velocity of the combustible gas at the burner port and on the mixture ratio. No effect of mixture ratio was found.

Theoretical Aspects of Driving Oscillations

Using the data presented thus far as background material, it is now possible to discuss the theoretical considerations leading to a postulation of the mechanism of oscillation. It will be shown how Rayleigh's criterion[4] can be applied to these oscillations and what components of the heating unit are involved in the generation of oscillations. In connection with the discussion of the mechanism of oscillation, the separate effects of primary air flow, firing rate, and furnace volume on the amplitude of oscillation will be brought out.

Rayleigh's Criterion

One of the basic hypotheses which explain oscillations in combustion systems was first proposed by Lord Rayleigh[4]. Appendix A has been devoted to a fuller explanation of his criterion. For this discussion, however, it is sufficient to state that an oscillation can be sustained when the rate of heat release of a flame is a maximum when the pressure of the system is a maximum or, conversely, when the rate of heat release of the flame is a minimum when the pressure is a minimum. If one or the other of these conditions is met and the driving force exceeds the damping losses, then an oscillation will be sustained. It should be noted that 2 events are involved in this criterion; there must be some means by which a periodic pressure fluctuation is present at the flame and there must be a periodic variation in the rate of heat release of the flame. Applying these conditions to a gas-fired single-port heating unit, it will be shown that the required pressure fluctuations arise from a Helmholtz-type oscillation of the volume of gases in the furnace or boiler into and out of the inlet openings and the stack. The periodic variations in the rate of heat release occur as a result of vortex shedding from the burner lip.

Pressure Variation in Heating Unit

Combustion of a turbulent gaseous mixture at and beyond the burner lip is a partially random process and as such would produce random noise. However, because the burner is contained within a volume in the furnace or boiler, the burner will be in an environment having one or more resonant frequencies. Therefore, although the flame produces noise at many frequencies, those frequencies which are equal to the resonant frequencies of the furnace or boiler will be accentuated. Thus, a standing wave of fluctuating amplitude will be set up inside the furnace or boiler. The internal volume of most drum-type furnaces, for instance, is such that the Helmholtz resonant frequency will fall in the range of frequencies between 40 and 80 cps. It is this mode of oscillation that is of major concern to this discussion.

In the subsequent discussion, the resonant frequency of the heating unit will be assumed as constant for any given configuration. The resonant frequency is a function of the volume of the combustion chamber, the configuration of the inlet region of the heating unit, and the absolute temperature of the gases in the stack. These items varied during the course of the different investigations; thus, the resonant frequency also varied. However, this variation was believed to be small, and was considered negligible in the following discussion.

Possible Sources of Driving

Periodic variation in the rate of heat release required to sustain oscillation can be provided by vortices passing through the flame. The cause of these vortices, however, has to be understood before the mechanism of oscillation can be fully determined.

The presence of these vortices could be explained by 2 different mechanisms. It was possible that a pressure oscillation in the furnace would cause a pressure oscillation of the same frequency to occur in the burner tube. Whereas the pressure amplitude at the spud would be essentially zero, the pressure at the burner outlet would correspond to that of the furnace. Therefore, there would also be a velocity fluctuation at the burner outlet. During part of a

complete velocity fluctuation cycle, the mixture would emerge from the burner in the form of a jet whereas during a later portion of the cycle, under severe oscillating conditions, the gases would flow back into the burner much like water flowing coreless-fashion into a drain. This fluctuation in velocity could cause vortices to shed periodically from the burner lip. The frequency of these vortices would be the resonant frequency of the furnace with the magnitude governed by the length of the burner tube as well as the amplitude of oscillation in the furnace. The second possibility suggested was that the vortex shedding was an aerodynamic rather than an acoustic phenomenon. Thus, it would be dependent only on the port diameter and the average combustible gas velocity.

The first mechanism was found not to be the principal cause of the vortices when more extensive studies were made of the effect of changes in burner-tube length on the amplitude of oscillation (Appendix B). However, as will be shown later, this effect does seem to be present in a small way, and may tend to regulate the shedding of the vortices at high primary air-flow rates. By taking high-speed movies of the flame, with the burner outside of the furnace, it was found that the vortices still were present and that, in the absence of a furnace with its own resonant frequency, their frequency was a function of the combustible gas velocity. Once this fact had been established, the mechanism could be postulated.

Aerodynamic Vortex Shedding as a Source of Driving

Vortex shedding from objects immersed in fluid streams is not an uncommon occurrence in nature[5]. One way to determine if a vortex shedding is of the aerodynamically induced type is to perform a correlation of 2 dimensionless parameters which involve the frequency of the disturbance, the physical size of the object, and several flow properties of the fluid. For this correlation the Strouhal number ($v\ D/V$) is plotted as a function of Reynolds number ($\rho\ VD/\mu$). The terms in these dimensionless groups are defined as follows:

v = frequency of the disturbance, cycles per second.
D = diameter of the object, feet.
V = average velocity of the fluid, feet per second.
ρ = density of the fluid, pounds per cubic foot.
μ = absolute viscosity of the fluid, pounds per foot per second.

In this particular correlation, v is the average frequency of vortex shedding obtained from a frame-by-frame analysis of the high-speed movies, D is the burner-port diameter, and V is the average velocity of the combustible mixture flowing out of the burner port. ρ and μ were found for the gas and air mixtures at the conditions when the movies were taken.

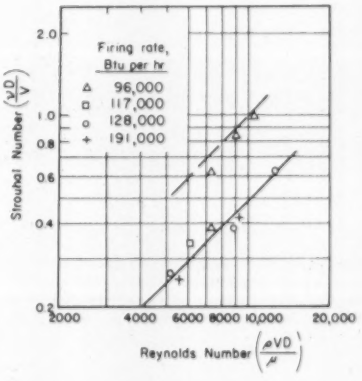

Fig. 4 — Strouhal number as a function of Reynolds number for the single-port burner external to the experimental furnace

Fig. 4 is a log-log plot which shows the results of this correlation when applied to 2 independently run sets of data for the single-port gas burner outside of the furnace. The values used to obtain the data points are presented in Table B-1 of Appendix B. The conditions under which each set of data was obtained were duplicated as well as possible. The 3 high points could represent errors in determining the vortex-shedding frequencies or, more likely, vortex shedding at double its fundamental or normal frequency as indicated by the dashed line. Such a phenomenon has been reported occasionally in the literature. The remainder of the data scatter by only a small amount about the solid line with a one-to-one slope. It is felt that this correlation is significant, and indicates that the frequency of vortex shedding is dependent principally on the average velocity of the combustible gas flowing out of the burner tube, and to a lesser extent, if any, on the burner port diameter. It should also be noted that firing rate, which was varied widely for these studies, did not affect the correlation, except that a low-firing rate and high Reynolds number seemed to provide the second mode frequency of vortex shedding.

The production of vortices from the end of a tube through which a fluid is passing has been reported by Wille, Domm, and Wehrman[6]. They present results on vortex shedding from the lip of a nozzle through which a fluid is passing at low velocities. This report gives a confirmation to the phenomenon of vortex shedding observed during the experimental work, and to the general relation observed between the dimensionless groups.

After the vortices shed from the burner lip, they pass through the flame front where they momentarily change the rate of heat release of the flame. Since the passage or vortices is periodic, it can be expected that the variation in the rate of heat release will likewise be periodic.

Experimental Verification of the Mechanism of Oscillation

As has been shown, the oscillation present in gas-fired single-port heating units results from a pressure fluctuation and a variation in the rate of heat release. It is the coupling

or phasing between these components which determines the amplitude of the oscillation. Obviously, when the coupling is precise, the amplitude will be a maximum. This will occur when the normal frequency of vortex shedding is equal to the resonant frequency of the furnace or boiler. An oscillation of reduced amplitude may still be sustained when the normal frequency of vortex shedding is either less than or greater than the resonant frequency of the heating unit.

If the 2 frequencies were distinct and different, and no interaction took place, then this difference in frequency would result in a beat phenomenon. However, the frequencies are not distinct. Both the resonant furnace frequency and the normal frequency of vortex shedding are *sloppy*. Furthermore, recent work by Garber[7] has shown that in an axially symmetric vortex-shedding system, the presence of a driving frequency will, in some manner, help time the vortex shedding. By Rayleigh's criterion, the proper input of heat resulting from the vortex shedding will drive the acoustic oscillation. Thus, the 2 oscillating systems couple or interact, with a feedback system set up. However, one still expects that as the frequency of the 2 basic components draw apart, the amplitude of oscillation involved in the system will decrease. Furthermore, at some point it will be expected that the feedback system will break down, and the oscillation will take on more and more of the characteristics of a beat phenomenon. In practice, this may show up as a surging as is defined in the terminology.

Changes in Primary Air-Flow Rate

Fig. 4 showed a definite correlation between Strouhal number and Reynolds number for flow through a burner external to a heating unit. If the burner port diameter, mass density, and absolute viscosity are assumed constant, then a plot of vortex-shedding frequency as a function of average combustible gas velocity can be made. A plot of this nature would indicate that this frequency increased with increasing velocity. If at low primary air-flow

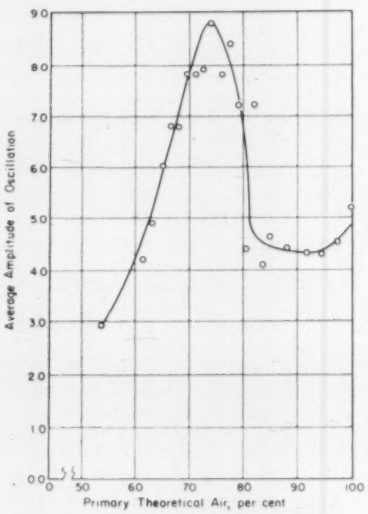

Fig. 5 — Average amplitude of oscillation as a function of primary theoretical air for the single-port gas furnace at a firing rate of 191,000 Btu per hr input

rates, the frequency of vortex shedding was less than the resonant frequency of the heating unit, then as the primary air was increased, the amplitude of oscillation would first increase, reach a maximum when the vortex shedding and furnace frequency were the same, and then decrease.

Fig. 5 shows data confirming the deduced result. These particular data were obtained using the experimental furnace with an internal volume of 4.66 cu ft and a firing rate of 191,000 Btuh input. As the figure shows, there are 2 regions of low-amplitude oscillations; one to the left of the peak, the other to the right. It is the region to the left of the peak, characterized by low-primary air-flow rate, which represents conventional practice in the industry.

It is also evident from the figure that there is an increase in the amplitudes of oscillation as values of primary theoretical air approach 100 percent. This effect is to be expected and results from increases in flame speed. If data were obtained at air-fuel ratios greater than stoichiometric, then it would be expected that the trend would be for lower oscillation amplitudes.

Change in Firing Rate

Fig. 6 shows the effect of change in firing rate on the amplitude of oscillation. For a furnace volume of 4.66 cu ft, the 2 firing rates were 128,000 Btuh and 191,000 Btuh input. As can be seen from the figure, the curve for the higher burning rate reaches a maximum at a lower value of percent primary theoretical air than does the curve for the lower firing rate. This occurs because the quantity of air required to obtain the same percent primary theoretical air is greater for the higher firing rate than it is for the lower. Thus, the velocity of combustible gas flow is greater. Since the frequency of vortex shedding is a function of this velocity, the condition where the vortex-shedding frequency is equal to the resonant frequency of the heating unit is reached at a lower percent of primary theoretical air for the higher firing rate for the lower. The higher amplitude for the 191,000 Btuh firing rate results from the increased energy available for driving.

Changes in Heating Unit Volume

Fig. 7 is presented to show the effect of changes in heating-unit volume on the amplitude of oscillation. The firing rate for these data was 191,000 Btuh input. These changes in volume were accomplished by inserting closed cylinders of various volumes inside the experimental furnace. As this figure shows, the maximum amplitude is shifted to higher values of percent primary theoretical

air for smaller net furnace volumes. Decreasing the furnace volume will raise the resonant frequency of the furnace and thus require a higher rate of primary air to achieve a vortex-shedding frequency equal to the resonant frequency of the furnace.

Concluding Remarks

It has been shown that the mechanism of oscillation in single-port gas-fired heating units involves a vortex-shedding phenomenon at the lip of the burner tube. The presence of periodic vortices passing through the flame front produces a periodic change in the rate of heat release of the flame. At the same time, there is a pressure oscillation in the volume of the heating unit whose frequency, in the absence of driving effects, would be equal to the frequency of the unit. The coupling which exists between the rate of heat release of the flame and the natural pressure oscillation governs the amplitude of oscillation produced by the heating unit.

Several methods of suppressing gas-flame oscillations are suggested by the mechanism of oscillation. The oscillation depends on the presence of a pressure fluctuation, periodic variation in the rate of heat release, and the coupling between the two. Thus, any means which will change any one of the 3 may reduce the amplitude of oscillation. If the natural frequency of the pressure fluctuation is changed so that the difference between it and the normal frequency of vortex shedding is increased, then the amplitude of oscillation will be reduced. To do this, however, requires a change in the volume of the heating unit; thus, this technique is normally not of practical interest.

Changing the normal frequency of vortex shedding, on the other hand, offers a much more practical approach to reducing the amplitude of oscillation. In this light, 2 different techniques appear to be of value. One technique would involve attaching a device to the lip of the burner which could serve to perform one of several functions. It could either tend to restrain the vortex, cause it to shed continuously, or break the large vortex into many smaller ones which will decay more rapidly. It is also possible to change the frequency of vortex shedding by changing the burner-port diameter or the velocity of the combustible gas or both. As has already been stated, the frequency of vortex shedding increases with increasing velocity. The frequency of vortex shedding will also vary with the burner-port diameter, but how it varies is dependent on the slope of the Strouhal-Reynolds number curve. In the data presented herein, the variation was slight, if it existed at all. In any case, it is possible to change the frequency of vortex shedding in such a way as to increase the difference of frequency between the vortex shedding and the pressure fluctuation.

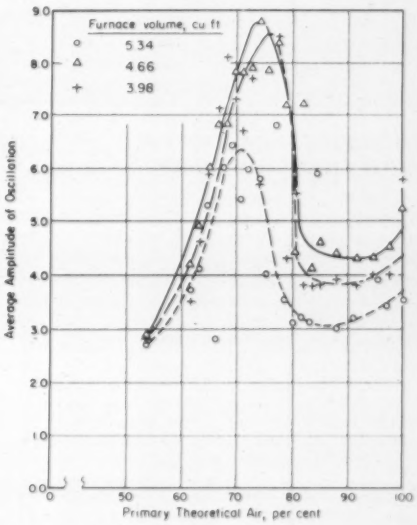

Fig. 7 — Average amplitude of oscillation as a function of primary theoretical air, three furnace volumes and a firing rate of 191,000 Btu per hr input

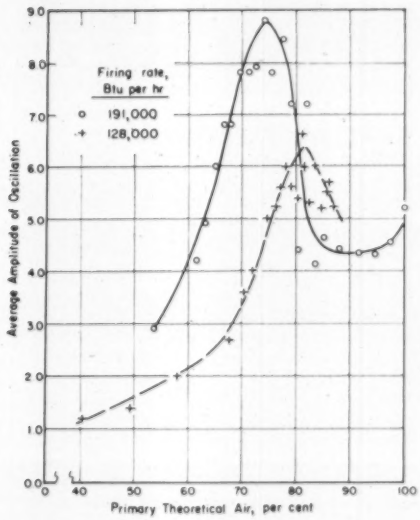

Fig. 6 — Average amplitude of oscillation as a function of primary theoretical air for a furnace volume of 4.66 cu ft and 2 firing rates

Acknowledgment

This research is sponsored by the American Society of Heating and Air-Conditioning Engineers, the *American Gas Association*, and the *Oil-Heat Institute of America*. The project is guided by representatives

of each of the sponsors on the Pulsation Research Steering subcommittee of the ASHAE TAC on Combustion. The able assistance of the members of that subcommittee not only in guiding the work but in providing necessary information and materials is gratefully acknowledged. Special thanks are due to the personnel of the Armstrong Furnace Co., Columbus, Ohio, who provided the experimental furnaces used. It is also desired to acknowledge the assistance of W. R. Dennis in obtaining various portions of the data used herein.

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ENGINEERS MUST KEEP UP WITH CHANGING TIMES

Engineers — new graduates or 40-year veterans — must keep up with developments of applied science or rapidly become non-professionals. So stated the board of directors of *Engineers Joint Council* following a recent session devoted to the changing role of the engineer. In a statement, the board warned of the results.

"The swift change in the nature of scientific and engineering activity now demands men and women in the engineering profession who can ride with the times, reorienting themselves with the new discoveries that are made every day. An indication of this emphasis on change is the fact that 20 to 25 percent of all engineers participate in research and development programs. The engineer must apply analytical thinking to a degree that was characteristic of only the creative few, several years ago. He must know about other fields of engineering in addition to his own specialty. Advanced training has become important in his life."

The dissatisfaction of older engineers over the distorted salary scales favoring recent graduates was noted in the following portion of the statement:

"The practicing engineer must realize his education is not completed when he gets his diploma. Many of those graduating from engineering colleges not too many years ago had a minimum of training in mathematics and physical sciences. That is all they needed at that time. Now, if he does not, on his own or through formal trainings, gain background in these areas that have become important, he finds himself a second-rate engineering citizen with little market value.

Engineers must undertake a retreading program even broader than the one that proved so successful during the last world War. The responsibility for assuring that we do not lose this valuable resource — the mature engineer — because of obsolescence, rests on many shoulders. It is the responsibility first of the individual engineer himself, but also of the employer and the engineering societies. Individual and collective measures must be taken to assure that educational opportunities are there for engineers to supplement their background in order to make the maximum contribution to our society and our defense.

There is a choice each engineer must make. Either he must appreciate the new environment in which he lives or he must be content with the lesser rewards of the nonprofessional. Chronological age is unimportant. An engineer can continue making important contributions over many years, or, on the other hand, outlive his usefulness at thirty."

NOTICE OF SPECIAL MEETING

To All Members Entitled To Vote:

Notice is Hereby Given that a special meeting of American Society of Heating and Air-Conditioning Engineers, Inc., will be held at the Conrad Hilton Hotel, South Michigan Boulevard and Seventh Street, Chicago, Illinois, on December 1, 1958, at 10:00 o'clock A.M. Central Standard Time.

The objects of the meeting are (*a*) to vote upon the approval of the Agreement for Consolidation providing for the merger of American Society of Heating and Air-Conditioning Engineers, Inc., and *The American Society of Refrigerating Engineers*; (*b*) to authorize and empower the officers and directors to join with the officers and directors of *The American Society of Refrigerating Engineers* in making, executing, and filing a Certificate of Consolidation, and to take any and all further actions and proceedings necessary or desirable to effect the consolidation.

A copy of the Agreement for Consolidation is annexed hereto, made part hereof, and marked Exhibit I.

No other business will be entertained or acted upon at said special meeting.

The approval of the Agreement for Consolidation requires the affirmative votes of two-thirds of the members of each of the constituent societies entitled to vote, present, in person or by proxy, at the respective meetings called for such purpose.

A proxy is attached containing spaces for write in names, and you may signify thereon how you wish your vote to be cast. The proxy will be voted in accordance with your instructions; but if no instructions are given, it will be voted in favor of the consolidation.

By order of the Council.

E. R. Queer
President

A. V. Hutchinson
Secretary

Dated, New York, N.Y., October 18, 1958.

Evaluation of Filters for Removing Irritants from Polluted Air

By N. A. Richardson* and W. C. Middleton**, Los Angeles, Calif.

SUMMARY—Two air-filter media were evaluated by their effectiveness in reducing human sensory irritation resulting from Los Angeles *smog*. The sensory response of one group of subjects working in a filtered atmosphere was compared with the response of another similar group working in a non-filtered atmosphere in identical, adjacent rooms. Sensory response was measured daily and simultaneous measurements of the physical composition of the air were obtained.

Much of the testing was with activated carbon filters varying in air detention time between 0.032 and 0.0030 sec. A significant decrease in irritation was recorded over the entire range of air detention times. Differences in effectiveness with respect to air detention time were not statistically significant, although a trend of decreasing effectiveness was observed as air detention time was reduced. Effectiveness of activated carbon in removing oxidants was directly related to detention time. NO_2 was reduced by activated carbon during its early use.

A particulate filter which effectively removes particles having a diameter less than 0.05 microns was also tested. No decrease in sensory irritation was detected.

Correlations computed between measurements taken in the non-filtered atmosphere indicate that sensory irritation is highly related to oxidant level and moderately to temperature.

IT IS UNLIKELY that the *smog* problem will be *solved* on an area-wide basis in the near future. Pending this more desirable solution, however, it seems reasonable to attempt to control the quality of air brought into enclosed living and working spaces. Unfortunately, data are not available for use in the design of air filtering equipment for this application. With this in view, a research program was initiated to establish the effectiveness of various filter types for removing the irritants from smog polluted air.

Los Angeles *smog* currently is identified by such manifestations as eye, nose, and throat irritation, reduced visibility, and damage to agricultural crops and materials. The agents in polluted air which produce irritation and crop damage have not been identified. Filter effectiveness, therefore, cannot be established directly in terms of a change in chemical concentration, but must be measured in terms of the decrease in *smog* manifestations which attends a filter installation. In this study, differences in the sensory response of human subjects to filtered and unfiltered environments are used as a primary measure of filter effectiveness.

It should be recognized that such a method of evaluating filters does not insure the removal of carcinogens or other ingredients which may be harmful to health. However, it has not been established that the current level of community air pollution has a detrimental effect on health. When more is known about health aspects, it should be possible to design filtering equipment to remove causative agents. Improvement of human comfort and job performance efficiency is felt to be ample justification for the use of filters.

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**Associated Research Psychologist, Department of Engineering, University of California.

Presented at the meeting of the Chapters Regional Committee for Region 4 of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, Los Angeles, Calif., May 6, 1957.

Procedure

General: The tests were carried out in 2 rooms of the Pacific Telephone and Telegraph Building in downtown Los Angeles. One of the rooms was located on the 7th floor and the other was immediately above it on the 8th floor of this building. The rooms had identical floor plans, and were remodeled by the Telephone Company so that they were as identical as possible in all other respects.

In each test room there were approximately 20 young women who served as subjects during the testing program. The women in both rooms worked as typists and had similar levels of job responsibility.

Outside air was brought directly into the rooms in a single pass through the window-mounted ventilator-filter units shown in Fig. 1. Eight room-air changes per hour were provided regardless of the filter material being tested. Smoke tests indicated that the ventilator systems increased the pressure in the rooms to a level sufficient to prevent air from flowing into the rooms through the doors when they were opened; thus, the air brought into the test rooms was completely controlled.

It is important to note that these experiments were performed under completely real conditions. Neither the job situation nor the air pollution conditions were artificial.

Filter evaluation was accomplished by placing test filters in the ventilator units of one room while *dummy* filters matched for impedance to air flow were placed in the ventilator units of the other room. The sensory response of the subjects to their immediate air environment was measured by means of a Daily Questionnaire, which was filled out by each subject. The Daily Questionnaire provided a composite measure of ir-

ritation which presumably indicated the subject's total response to the immediate atmospheric environment. The test filters were switched periodically so that the room occupants were alternately exposed to test and control conditions. Although the occupants knew the general nature of the test, they were never told whether the filters within their room were active or not.

Fig. 1 — One of the test enclosures showing filter installation

The Daily Questionnaire was passed out each work day at 11:00 a.m. by the room supervisors, and concurrently, physical measurements of the air were made in each of the 2 rooms and immediately outside the building. Four different measures of the physical composition of the air were made. These included a measurement of particulate matter, nitrogen dioxide, and total oxidants by 2 different methods. Measurements of temperature, relative humidity, and room illumination were also obtained.

A preliminary sampling program was undertaken to establish the reliability and sensitivity of the questionnaire method of measuring sensory irritation, and to determine if differences existed in the response of the two groups. During this period *dummy* filters were placed in the ventilator units of both rooms. The results of this study were very encouraging. Good consistency was obtained between the response of individuals within a given test group as well as between the average response of the 2 test groups. The maximum possible response on the Daily Questionnaire is 22 irritation units. It was found from this study that a 3-unit variation of the Mean Index of Irritation of either test group is statistically significant to the 5 percent level.† The correlation between the mean response of the 2 groups during this period was 0.93.

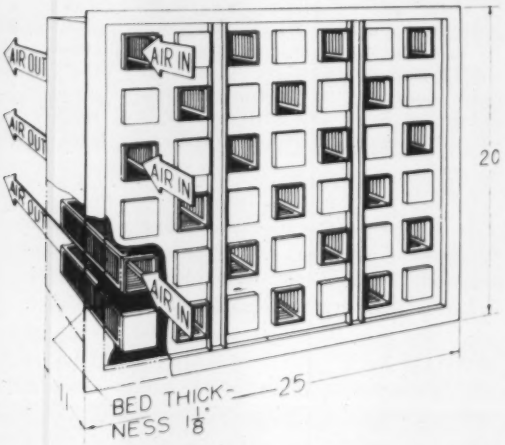

Fig. 2 — Activated carbon air filter

Evaluation of Activated Carbon: Activated carbon was selected as the first filter material to be tested because some preliminary evidence indicated that this material was effective in reducing *smog* manifestations. This information, however, was inadequate, in terms of quantity and scientific control, to be of use in the design of activated carbon filters to meet specified requirements.

The filter unit in which the activated carbon was placed for testing is illustrated in Fig. 2. The filter bed, which has a thickness of 1⅛ in. and an effective area of approximately 10 sq ft, was filled with a 50-min‡ coconut shell carbon.

If the rates of adsorption of the irritating substances by the filter bed are controlled by the rate at which the materials diffuse into the pores of the activated carbon and not by the rate of diffusion from the air stream to the surface of the carbon (this is generally the case), then the mass transfer rate is essentially independent of air velocity in the filter bed. Under this condition, the time the air remains in contact with the filter bed becomes a significant parameter in predicting changes in concentration of the irritants. The effectiveness of activated carbon, therefore, was evaluated as a function of air detention time, t_d, where

$$t_d = 60\ l\ A_e\ P/Q \quad \ldots\ldots\ldots\ldots (1)$$

and

t_d = air detention time within the filter bed, seconds.
l = actual bed thickness, feet.
A_e = effective area of filter bed, square feet.

† A three unit variation in the Mean Index of Irritation would occur less than 5 times in 100 by chance alone.

‡ Based upon the standard test for chloropicrin *breakthrough*.

Q = air flow rate, cubic feet per minute.
P = bed porosity, percent voids.

The time during which the air is detained in the filter bed has been calculated by using the rather standard assumption that the activated carbon bed has a porosity of 50 percent. Laboratory measurements indicate the actual porosity was approximately 47 percent.

For practical reasons, changes in air detention time were accomplished in 2 ways. The first reduction in air detention time was achieved by replacing one of the 2 activated carbon filter units, originally contained in each ventilator, by a *dummy* filter. Thus, air detention time was cut in half while the velocity of air past the activated carbon remained constant. Subsequent reductions in air detention time were achieved by blocking off portions of the remaining filter, so that bed thickness remained constant, but the air velocity was increased.

The first activated carbon tested gave off a definite odor shortly after it was put into operation. It was possible that this carbon had been used previously and not properly reactivated; therefore, it was replaced, after a period of 6 weeks, by new carbon. Although the new activated carbon also gave off a *sweet* odor after an operating period of several weeks, it was not changed again during the course of the experiment, in order that some indication of filter life might be obtained. It was originally planned to change the carbon whenever the effectiveness of the filter in reducing sensory irritation decreased significantly. In this manner,

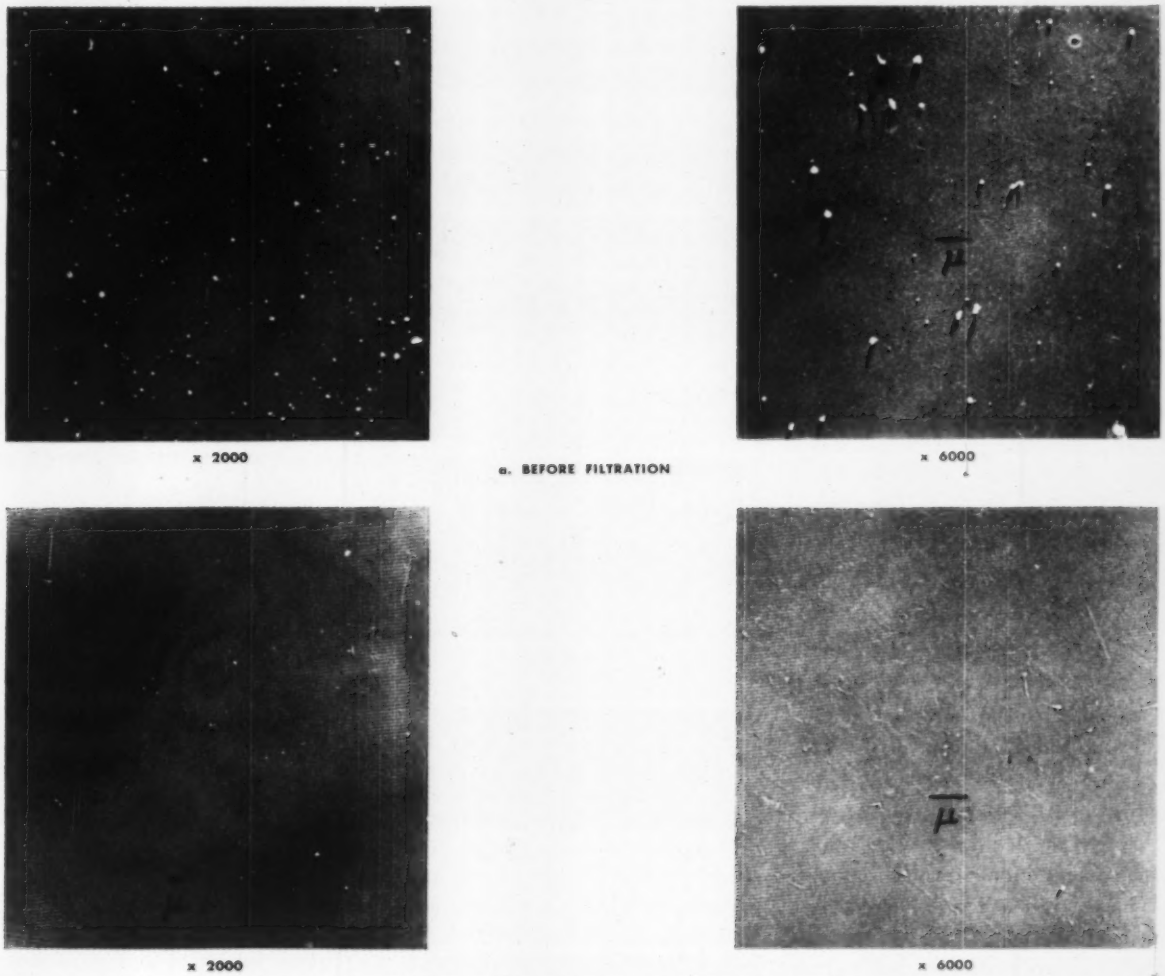

Fig. 3 — Electron micrographs of particulate material in air on a smoggy day

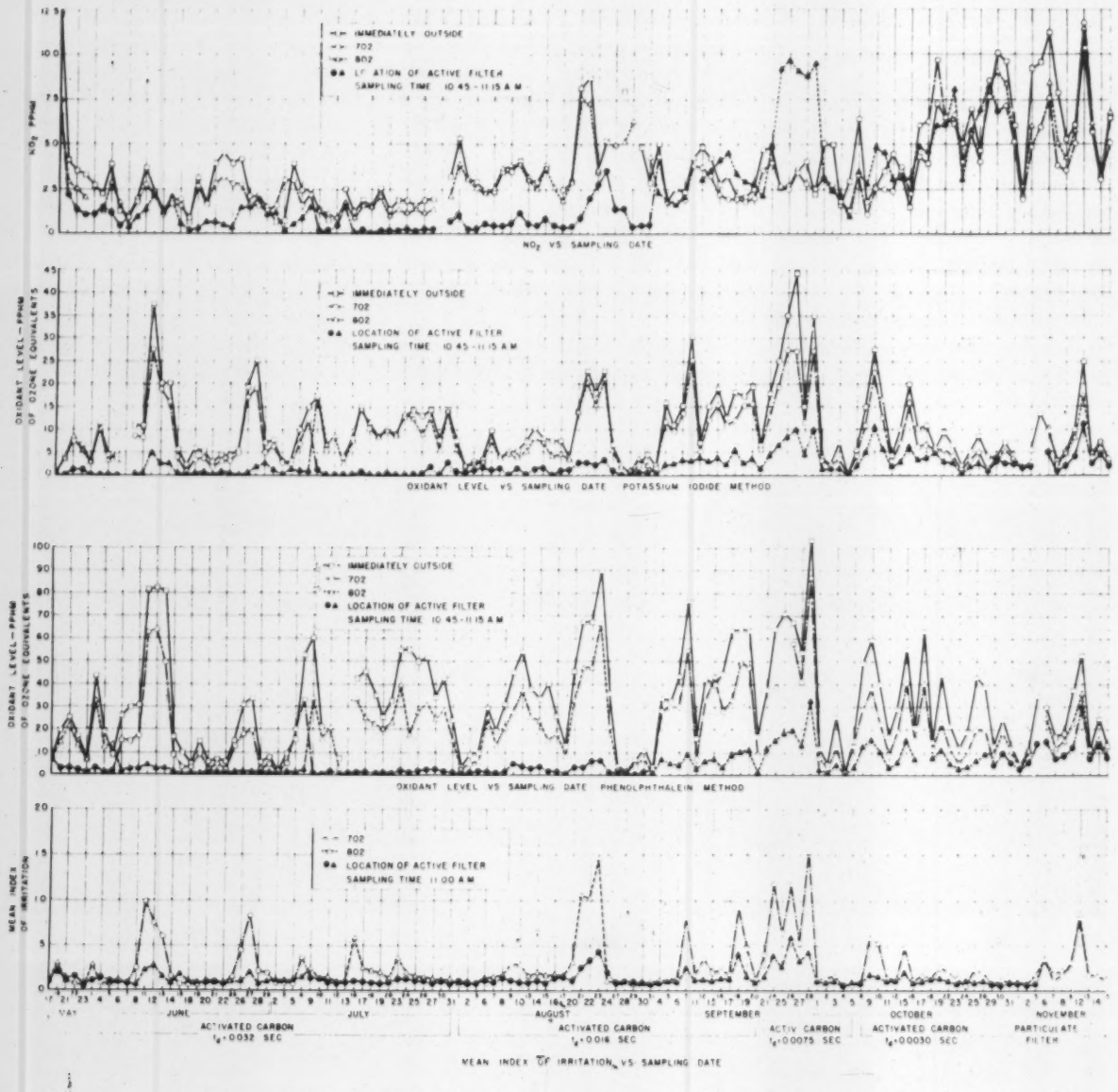

Fig. 4 — Sensory irritation, oxidant and nitrogen oxide concentrations vs sampling date

it would be possible to determine the extent to which the reduced effectiveness was due to the accumulated exposure of the carbon to polluted air. However, a significant decrease in effectiveness did not occur during the estimated 650 hours of filter operation.

Evaluation of a Particulate Filter: Subsequent to the evaluation of activated carbon, a highly efficient particulate filter was tested using the same procedures. A filter carrying a guaranteed maximum penetration of less than 0.03 percent by particles 0.3 microns in diameter, based on particle count, was selected for this purpose. Because a significant portion of the particulate matter in the atmosphere on *smoggy* days is smaller than 0.3 microns, several samples of particulate material in the air stream before and after filtration were taken to determine if the filter would remove the smaller particles. The samples were collected using a thermal precipitator. The electron micrographs of Fig. 3 are presented to suggest the effectiveness of this filter in removing submicron particles. Based upon an actual count of particles having diameters greater than 0.01 microns, the filter was found to be 89 percent effective. It

is interesting to note that the mean particle size in the sample taken before filtration was approximately 0.05 microns and after filtration was approximately 0.1 microns.

Results

General: The time required for a particular filter test was necessarily determined by the frequency and intensity of *smog* conditions. The data presented were obtained during 123 sampling days from the 15th of May through the 15th of November, 1956.

Fig. 4 presents measurements of irritation, NO_2, and oxidant level, obtained simultaneously within the 2 test rooms and immediately outside the building, plotted as a function of sampling date. Certain effects of the different filters upon irritation scores and chemical measurements as well as some correlations are readily apparent in glancing at this figure. These effects and correlations are discussed in some detail later in this section.

An indication of error in the physical measurements was obtained by simultaneously sampling air at a single location with the 3 sampling units used during the filter evaluation program. Simultaneous measurements were taken on 12 different occasions under different *smog* conditions. The differences between the 3 sampling units were, on the average, 6 percent of the average measured value in the case of oxidant measurement by the phenolphthalein method, 8 percent of the average measured value in the case of oxidant measurement by the potassium iodide method, and 12 percent of the average measured value in measuring NO_2. Simultaneous measurements using the 3 particulate sampling units revealed an average difference of approximately 15 percent of the average measured value.

Correlations between measurements taken outside the building and in the non-filtered room, during the filter evaluation program, provide the best over-all indication of the reliability of the physical measurements. These correlations are influenced both by error of measurement and variable factors at each sampling location which influences the measurements in a differential manner. Because the active filters were periodically shifted from one room to the other and hence each room was in the non-filtered position for approximately half the duration of the study, the correlations apply equally well to both test rooms.

The correlation between values measured outside the building and in the non-filtered room during the 123 days of filter evaluation was 0.95 in the case of oxidant measurements by the phenolphthalein method, 0.93 in the case of oxidant measurements by the potassium iodide method, 0.90 for the NO_2 measurements, and 0.52 for the particulate measurements. The correlations thus indicate that, with the exception of the particulate measurements, the physical measurements were reliable. The low correlation in the case of the particulate measurements is apparently due both to the lack of reliability of the measurements and to the fact that dust was sporadically stirred-up in the test rooms by the room occupants while the measurements were being taken. Cigarette smoke may also have had some effect upon this measurement although usually the women did not smoke during office hours.

Table 1—Effect of filter upon sensory irritation and chemical measurements

Test Condition	Irritation	Oxidants		NO_2
		Ph	KI	
[a]0.032 Activated Carbon Filter				
Mean (non-filtered room)	1.99	23.9[b]	9.8[b]	1.5[b]
Mean (filtered room)	1.01	1.3[b]	0.49[b]	0.41[b]
Difference Between Means	0.98	22.6[b]	9.4[b]	1.1[b]
Probability that the Difference could have occurred by chance	<0.01	<< 0.01	<< 0.01	<<0.01
0.016 Activated Carbon Filter				
Mean (non-filtered room)	2.95	24.4[b]	8.4[b]	3.4[b]
Mean (filtered room)	1.41	3.6[b]	1.8[b]	1.6[b]
Difference Between Means	1.54	20.8[b]	6.7[b]	1.8[b]
Probability that the Difference could have occurred by chance	<0.01	<< 0.01	<< 0.01	<<0.01
0.0075 Activated Carbon Filter				
Mean (non-filtered room)	5.45	28.9[b]	13.9[b]	2.7[b]
Mean (filtered room)	2.35	10.1[b]	4.9[b]	5.7[b]
Difference Between Means	3.10	18.8[b]	9.0[b]	3.0[b]
Probability that the Difference could have occurred by chance	<0.05	< 0.01	< 0.01	diff not signif
0.0030 Activated Carbon Filter				
Mean (non-filtered room)	2.35	19.5[b]	7.3[b]	4.7[b]
Mean (filtered room)	1.19	8.1[b]	3.6[b]	4.9[b]
Difference Between Means	1.16	11.4[b]	3.7[b]	0.2[b]
Probability that the Difference could have occurred by chance	<0.01	< 0.01	< 0.01	diff not signif
Particulate Filter				
Mean (non-filtered room)	2.13	14.9[b]	5.7[b]	6.3[b]
Mean (filtered room)	1.91	10.0[b]	3.4[b]	5.5[b]
Difference Between Means	0.22	4.9[b]	2.3[b]	0.8[b]
Probability that the Difference could have occurred by chance	diff not signif	< 0.01	< 0.01	< 0.02

[a]Refers to Air Detention Time in seconds.
[b]Figures are in pphm.

Evaluation of Activated Carbon Filters: First consider if activated carbon removes the substances in *smog* which produce sensory irritation. Fig. 4 shows that the irritation level in the room receiving activated carbon filtered air was always lower than that experienced in the directly ventilated enclosure if only those days are considered during which the irritation level was significant (3 or more irritation units). This is true even though the air detention time in the activated carbon filter bed was reduced from 0.032 to 0.0030 sec-

onds. Table 1 summarizes the data of Fig. 4 by comparing the mean response of the groups in the filtered and non-filtered room during the operation of each test filter. The statistical significance of the computed differences between mean scores was evaluated using the Sign Test[1] which involves no assumptions regarding the nature of the distribution of irritation scores. The computed level of significance indicates the probability that a given difference in mean scores could have occurred by chance. Because the differences in the mean irritation scores between the filtered and non-filtered test situations were in all cases highly significant it can be concluded that activated carbon does remove the substances in *smog* which produce sensory irritation.

There were certain periods, however, during which a significant amount of irritation was experienced in the filtered room. A review of the irritation measurements shown in Fig. 4 reveals that a significant level of irritation (3 irritation units or more) was experienced in the non-filtered space on 25 of 109 sampling days while the level of irritation in the filtered room became significant on 5 days. On the 5 days during which a significant level of sensory irritation was recorded in the filtered room the Mean Index of Irritation in the non-filtered space was 9 units or higher. Based upon the wording of the Daily Questionnaire a score of 3 indicates *barely noticeable* irritation, a score of 7 indicates *moderate* irritation, and a score of 11 indicates *severe* irritation. Thus it was found that *barely* noticeable irritation was experienced in the filter-protected room on days producing *high-moderate* to *severe* sensory irritation in the non-filtered enclosure. Although activated carbon does remove the irritating substances, apparently some of these materials did penetrate the test filter bed on days of intense *smog*.

[1]Exponent numerals refer to References.

Effectiveness as a Function of Air Detention Time: Air detention time in the activated carbon bed was systematically reduced during these experiments to establish filter effectiveness as a function of this design parameter. It should be noted that a comparison of the magnitude of the difference between means of the scores recorded in the filtered and non-filtered enclosures for each different filter condition does not provide a measure of the relative effectiveness of various filter conditions. This results from the fact that the difference between means is directly affected by the magnitude of the measurements; and these magnitudes depend entirely upon the severity of a *smog* episode.

In seeking a way to compare filter conditions, it was found upon plotting the data that the relationship between corresponding measurements taken in the filtered and non-filtered test locations, although slightly nonlinear, could be approximated closely by a straight line. Stated another way, it was found that a constant ratio existed between corresponding filtered and non-filtered test measurements for each different filter condition. This was true of the irritation scores as well as of the chemical measurements. An indication of filter effectiveness which is relatively independent of the absolute magnitude of the original measurements, therefore, can be obtained by taking the ratio of each filtered to its corresponding non-filtered measurement and computing the mean of the ratios for each of the test filter conditions. The mean ratios provide only suggestive information in the case of the irritation scores because it is not possible to state that an irritation score of 4 represents twice as much irritation as a score of 2.

Computed mean ratios between measurements taken in the filtered and non-filtered test situation are presented in Table 2. The mean ratios of irritation scores tend to increase as air detention time is decreased thus suggesting that filter effectiveness decreases as the air detention time in the activated carbon bed is decreased. An exception to this trend occurs, however, at an air detention time of 0.0030 sec. This exception very likely results from the fact that these tests were run during a period when *smog* intensities were lower than average. Because the computed mean ratios are not completely independent of the magnitude of the original measurements, a lower mean ratio would be expected.

The mean ratios between oxidant concentration in the filtered and non-filtered areas as measured by both the potassium iodide and phenolphthalein methods increase as the air detention time is decreased. NO_2 concentration was reduced by activated carbon during the early period of its use, but after the same activated carbon filter had been in operation for approximately 2 months, the NO_2 concentration in the filtered room increased. Four periods occurred during which the NO_2 concentration in the filtered room was higher than that in the non-filtered room. Two of these periods occurred immediately after the only 2 occasions on which filter air detention time had been decreased by increasing the air velocity past the carbon. It has also been observed that high NO_2 concentrations in the filtered room generally occurred during periods of above normal temperature, although there were exceptions to this. The apparent breakthrough of NO_2 seems to have had no effect on the irritation scores in the filtered room. Likewise, no relationship was found between the NO_2 and irritation measurements in the non-filtered room.

Evaluation of a Particulate Filter: Inspection of the data presented in Fig. 4 and summarized in Table 1 clearly shows that the use of a highly efficient particulate filter to remove airborne particles has little effect upon the level of sensory irritation

produced by *smog*. This suggests that particulate material is not important in the mechanism of sensory irritation. This conclusion is further substantiated by the fact that the computed correlation coefficient for the relationship between particulate count and sensory irritation, as measured in the non-filtered room, was very low (0.15), and the correlation between outside measurements of particulate count and oxidant level, where oxidant level has been shown to correlate highly with irritation, was 0.10. These results agree with evidence reported by the Stanford Research Institute to the effect that *removal of all of the particulate constituents had little effect on the eye-irritating action of artificial smog*[2].

Table 2—Effect of filter upon sensory irritation and chemical measurements
(expressed as a mean ratio of the measurements taken in the filtered and non-filtered rooms)

Test Condition		Irritation	Oxidants		NO_2
			Ph	KI	
0.032[a]	ACF[b]	0.27	0.06[d]	0.04	0.26
0.016	ACF	0.32	0.16	0.23	0.61
0.0075	ACF	0.39	0.36	0.38	2.07
0.0030	ACF	0.34	0.43	0.54	1.23
Part. Filter[c]		1.06	0.67	0.64	0.85

[a]Refers to air detention time in seconds.
[b]ACF means: Activated Carbon Filer.
[c]Part. Filter means Particulate Filter.
[d]*Example*: During the operation of an activated carbon filter with an air detention time of 0.032 sec, the oxidant level in the filtered room was, on the average, 6 percent of the oxidant level in the non-filtered room, as measured by the phenolphthalein method.

Before dismissing particulate material as an important part of the Los Angeles problem, however, 2 points should be considered. First, although particulate material apparently is not directly related to the occurrence of sensory irritation, it is possible that particles are important when health aspects of the problem are considered. Second, although particles are not involved in the mechanism of eye irritation, they may play a part in the reactions by which the irritating substances are formed.

The particulate filter decreased the concentration of oxidants and nitrogen dioxide by a small amount as indicated by the data of Tables 1 and 2.

Correlations Between Measurements: Correlation coefficients have been computed between measurements taken in the room which was not filter protected to provide information which might be helpful in identifying the irritants in Los Angeles *smog*. These correlation coefficients are presented in Table 3. Based upon the standard error, correlation coefficients of 0.24 or greater are significant at the 1 percent level. The correlations between sensory irritation and oxidant concentration determined during this study are high and are of a magnitude similar to those obtained by other investigators[3]. Because errors of measurement will operate to decrease the correlation, the degree of relationship is probably higher than indicated. One cannot conclude from these correlations that the oxidants produce sensory irritation. It does appear, however, that the production of oxidizing material is linked in some way to the reactions which produce the irritating materials.

A plot of Mean Index of Irritation *vs* Oxidant Concentration reveals that the relationship is nonlinear. The curvilinear correlation coefficients, η, which best describe the data, however, are very little different from the linear correlation coefficients presented. One reason for this apparently is the fact that η is based upon grouped data while the product-moment correlation coefficient is based upon ungrouped data, thus avoiding error from this source.

In looking at the data of Fig. 4, a complex relationship between oxidant and nitrogen dioxide concentrations seems to exist. The correlation coefficient obtained over the duration of this study, however, is very close to zero. The correlation between sensory irritation and nitrogen dioxide also is essentially zero.

The positive correlation between sensory irritation and temperature and the negative correlation between irritation and relative humidity might have been expected from results obtained by Roth & Swenson[4]. These investigators found increased irritation from formaldehyde vapors with high temperatures and low relative humidities. It also is interesting to note that a relationship exists between temperature and oxidant concentration. Therefore, the positive correlation between sensory irritation and temperature may result from increased sensitivity on the part of the test subjects at higher temperatures as well as possibly higher concentrations of the irritating substances.

Table 3— Pearson product-moment correlation coefficients computed from measurements taken in the non-filtered room

Irritation	*vs*	Oxidants (Phenolphthalein Method)	0.81
Irritation	*vs*	Oxidants (KI Method)	0.81
Irritation	*vs*	NO_2	0.05
Irritation	*vs*	Particulate	0.15
Irritation	*vs*	Temperature	0.49
Irritation	*vs*	Relative Humidity	−0.24
Temperature	*vs*	Relative Humidity	−0.38
Temperature	*vs*	Oxidants (KI Method)	0.29
Oxidants (Phenolphthalein Method)	*vs*	Oxidants (KI Method)	0.88
NO_2	*vs*	Oxidants (KI Method)	−0.15

The correlation between sensory irritation and particle count is not significantly different from zero. One may question the significance of this correlation in view of the previously discussed low correlation between the particulate measurements made outside the building and in the non-filtered room. A separate check on this information is provided in the correlation between outside measurements of particulate count and oxi-

dant concentration, where oxidant concentration has been shown to be highly related to sensory irritation. This correlation is again not significantly different from zero.

It should be noted that the correlation coefficients presented were computed from measurements taken once a day at 11:00 a.m. It is possible that the correlations would be significantly different if based upon measurements made at other times of day. For example, it has been reported that sensory irritation persists long after the oxidant concentration has dropped[5]. Therefore, correlations based upon continuous measurements are important if one wishes to attempt the identification of the substances which produce sensory irritation.

Conclusions

1. A statistically significant reduction in sensory irritation is accomplished when Los Angeles *smog* is passed through activated carbon filters having air detention times at least as short as 0.0030 sec.

2. Although activated carbon removes *smog* irritants, some of the irritating materials apparently did penetrate the test filter bed on days of intense *smog*.

Note: The most demanding requirement of a filter system, designed to remove the irritants from area-wide pollution, is the purification of air which is drawn entirely from outside of the building. A considerable amount of experience has been gained, however, in the use of activated carbon for the purification of recirculated air[6]. This procedure reduces the amount of outside air which must be filtered, and also reduces the air-conditioning load in buildings where air-conditioning is employed.

3. The differences in effectiveness of activated carbon filters with respect to variations in air detention time between 0.032 sec and 0.0030 sec are not statistically significant. However, the ratios between corresponding irritation levels in filtered and non-filtered atmospheres indicate a trend of decreasing effectiveness as air detention time in the filter bed is reduced.

4. The effectiveness of activated carbon in removing oxidants is a function of air detention time. Effectiveness will be improved very little by increasing detention time beyond 0.032 sec, and it falls off at an increasing rate as detention time is decreased below this point.

5. NO_2 is reduced by activated carbon during its early use, but after a period of time, the NO_2 concentration in the filtered atmosphere increases and is frequently higher than in the non-filtered atmosphere. The reason for this apparent breakthrough has not been studied.

6. The removal of airborne particles down to a diameter less than 0.05 microns does not significantly decrease sensory irritation resulting from Los Angeles *smog*. These results, together with the correlation data, show that particulate material is not directly related to the occurrence of sensory irritation.

7. Correlations computed from daily measurements obtained in a non-filtered atmosphere at 11:00 a.m. indicate that sensory irritation is highly related to oxidant level and moderately related to temperature. A slight negative correlation has been computed between irritation and relative humidity. The correlations between irritation and NO_2 and between irritation and particulate count are not significantly different from zero.

Acknowledgments

The contributions of Jiri Sandera and E. S. C. Bowler to this research program are gratefully acknowledged. The authors also wish to thank Katherine W. Wilson, A. F. Bush, and J. D. Isherwood for their help and valuable counsel.

Particular thanks is also extended to the employees and officials of the Pacific Telephone and Telegraph Co., for their extreme cooperation. The company provided 2 of its offices as test enclosures and modified them to make the rooms as nearly identical as possible. Further, the company permitted the use of employees as test subjects.

This study was sponsored by the State of California.

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APPENDIX

Physical Measurements

Oxidant Measurements: One measure of oxidant concentration was obtained using the phenolphthalein method, as described by Haagen-Smit and Fox.[7] Air was bubbled through the reagent for 30 min at the rate of 1 liter per minute. The solution was then analyzed using a spectrophotometer at a wave length of 550 millimicrons.

The oxidant level was established in terms of ozone equivalents by calibrating the solutions against known quantities of ozone from a high-voltage discharge ozonizer. The ozonizer was calibrated by passing its output through potassium iodide and titrating with sodium thiosulfate.

Another measure of oxidant level was obtained by bubbling air, at the rate of one liter per minute, for 30 min, through potassium iodide in a phosphate buffer at a Ph of 7 — 7.2. The solution was then analyzed on the spectrophotometer at a wave length of 352 millimicrons.

Nitrogen Dioxide Measurement: Nitrogen dioxide was measured using a solution of sulfuric acid, N-(1-napthyl)-ethylenediamine dihydrochloride and acetic acid, according to the procedure suggested by B. E. Saltzman.[8] Air is bubbled through the solution for 30 min at the rate of 0.8 liters per minute. The solution is analyzed on the spectrophotometer at a wave length of 550 millimicrons.

Particulate Count: Particulate material was collected from the air with continuous thermal precipitators. The details of sampling equipment and counting techniques, using the electron microscope, are discussed in Reference 9.

Solar Radiant Gains Through Directional Glass Exposure

By R. D. Cramer* and L. W. Neubauer**, Davis, Calif.

SUMMARY—Results are reported from tests conducted with an 8-ft cubicle having one side constructed of glass. The cubicle was oriented in various directions with reference to the sun, and the solar radiant gains caused changes in the air temperature in the cubicle. Measurements of the temperature were made and were plotted in graphical form. The tests were conducted in Davis, Calif., where high daytime dry-bulb temperatures prevail throughout July and August, with cooler night temperatures, and where there is little if any summer rain. The cubicle was kept tightly sealed and there was little or no infiltration of air or ventilation. Tests were conducted with unobstructed glass as well as with various screening devices located inside the glass such as blinds, drapes and screens and with various shading devices located outside the glass. Tests were also carried out when the cubicle was completely shaded from direct sun radiation. Changes in the curves of inside temperature gave a comparative means of judging effect of each device tested, and an indication of effect of complete shade.

It is broadly generalized that inside screening devices which hang flat against the glass and which have smooth surfaces are better barriers against radiation than those which hang away from the glass. Also the results appear to bear out the importance of intercepting solar radiation before it enters a structure rather than afterwards.

The paper is in the nature of a progress report and the project is continuing. Further structural and environmental results are under observation. Results reported in this paper should not be applied except in areas where radiation values and temperatures are high and humidities are low.

THIS IS a description of some of the recent work of Western Regional Housing Project W-8 and University of California research project 1536. Reports on previous work concerned with temperature studies in an experimental house trailer and in existing inhabited houses have been published[1-6]. The trailer has small window openings, simulating a conventional house in which orientation is not critically important because the windows are distributed about evenly on all 4 sides and because radiant gains through the limited glass areas are comparatively low. Subsequently, an 8-ft cubicle was acquired to make available a structure in which orientation has a pronounced effect on interior air temperatures. The results obtained with its use form the basis for this paper.

The Cubicle

This unit was designed to represent a room or small house with a large proportion of its wall area given over to glass. It is 8 ft square and 8 ft high. It has a floor of ¼-in. plywood on 2 × 4-in. joists, without insulation.

Beneath is a low *crawl space* open to the outside air on all sides. Three of its walls are framed with 2 × 4-in. studs, insulated between with 2-in. mineral wool, and sheathed on both interior and exterior surfaces with ¼-in. plywood. They contain no windows. The flat roof-ceiling has the same construction.

The fourth wall is glass, 8 ft square, made of ⅛-in. sheet glass, simply framed. The framing is painted white, as are the other exterior wall surfaces and roof. The interior finish is natural DF plywood.

Fig. 1 shows the glass wall of the cubicle and gives some indication of the flat open terrain of its locale. The cubicle is portable and can be moved with a crane or large fork lift. However, for purposes of the tests described herein (except as indicated) one location only was used.

It should be noted that while the glass muntins are small in section, they do cast some shadow when taken in aggregate. A wall made of an uninterrupted sheet of glass might produce somewhat higher interior air temperatures than those recorded in Fig. 2 but probably the difference would be slight.

Instrumentation

The principal installation for obtaining temperatures in the cubicle consists of 12 thermocouples of copper and constantan wires located in the surfaces of the walls, roof, ceiling, and floor, as well as in the air indoors and out. Temperature readings were

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[1]Exponent numerals refer to References.

taken manually, every hour during the day, and occasionally at night, using a self-compensating standard electrical potentiometer (reading directly in F deg) and a 12-point switch. This equipment was kept and operated in one corner of the cubicle.

Fig. 1 — The cubicle (looking NNE). Showing glass and solid walls

As the hourly temperatures of roof, wall, floor, and air were read they were recorded by hand. Mercury thermometers and a recording hygrothermograph were used to verify thermocouple readings.

Climatic Conditions

These tests were conducted by the Experiment Station at the University of California at Davis located approximately in the center of California's Central Valley, latitude about 38½ deg N.

In this region the average daily maximum temperature in July and August exceeds 95 F. Temperatures above 90 F occur on 23 days of each month. Readings exceed 100 F on 9 days in July and on 7 days in August. Natural cooling usually takes place at night, however, as the average minimum for July and August in Davis is 54 F. Minimum temperatures fall below 60 F on 27 nights in July and on 28 nights in August. These figures are based on 40-year averages (1910-50) and were obtained from the University Weather Station located just a few hundred feet from the cubicle. University Weather Station data were also used to obtain the reported outside air temperatures.

In Davis the high mid-day temperatures are accompanied by low humidities, thus rendering the heat relatively less objectionable. But according to the 1956 HEATING, VENTILATING, AIR CONDITIONING GUIDE, the temperature zone found most comfortable in summer for people at rest, ranges from 71 F at 100 percent RH (relative humidity), to 76 F at 50 percent RH and to 82 F at 10 percent RH. These conditions are exceeded in the region during the heat of day for the full summer period.

Rain during the summer is virtually unknown. Even clouds and/or daytime winds are infrequent. The usual day is hot, dry, clear and still, followed by evening cooling breezes from the south. These conditions recur with a regularity surprising to one accustomed to eastern or midwestern climates.

Measurements

The cubicle was placed in an open field on plowed earth entirely unshaded except for low buildings and trees at some distance to the east and west. These produced partial shade during parts of the first and last hours of sunshine, but their effects were not substantial.

During June, July, and August 1956, temperature readings of the exterior and interior surfaces of the cubicle and of the inside and outside air were taken and recorded hourly from early morning until late evening. Data collected for the infrequent days which were windy or cloudy or cool were recorded but not used in the averages.

Each curve in the figures in the paper represents average temperatures for a period of not fewer than 3 typical days. Temperature readings were plotted using the outside air dry-bulb as a base. In each case the hourly readings of the average outside air temperatures for a particular 3- or 4-day run were subtracted from the hourly readings of average inside air temperatures for that run. The differences were then added to the average Davis summer air temperature curve for the recent 5-year period (1951-55) and so plotted. This method makes possible a direct comparison of the cubicle's performance during the several runs, regardless of differing outside air temperatures.

It should be noted that the 5-year curve is lower (cooler) than the older 40-year average. This difference partially can be explained by the fact that the 5-year average is for the entire summer while the 40-year average covers the 2 hottest months only. However, the more recent 5-year data does indicate somewhat lower temperatures. Whether this signifies a short-or a long-range trend is as yet unknown.

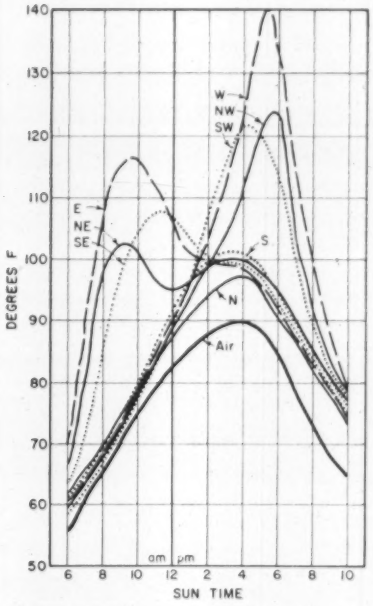


Fig. 2 — Effects of orientation. Showing the behavior of the inside air or room temperature at different glass orientations as compared with an average summer outside air or weather station temperature curve. The symbols represent cardinal and intermediate points of the compass

Climate is continually variable. No 2 days are exactly alike nor is there any such thing as perfect clearness, stillness, or dryness. Idiosyncrasies of individual days inevitably introduce irregularities in experimental results. In Davis during the summer these idiosyncrasies are represented to some degree by haziness and/or wind during the day, and by nocturnal southerly breezes which vary in magnitude. But the methods reported here seem reliable because several opportunities to verify earlier results have produced consistent measurements.

Plotting

In general, the figures shown in this paper represent the results of each experiment plotted first against the 5-year average summer outdoor air previously described, and then against the average outdoor air curve flattened out and represented as a straight line or zero reading. The former method shows the total thermal condition; the latter subtracts out convected exchange with the outdoor air and confines itself to radiant effects against the wood surfaces and through the glass.

In the attempt to include a number of curves on each graph to facilitate multiple comparisons, some difficulty in reading closely adjacent lines was encountered. To alleviate this condition, lines which actually overlapped and which in some cases crossed back and forth were straightened out and plotted as close parallells. Corrections used to make this possible never exceed 2 deg and seldom exceeded 1.

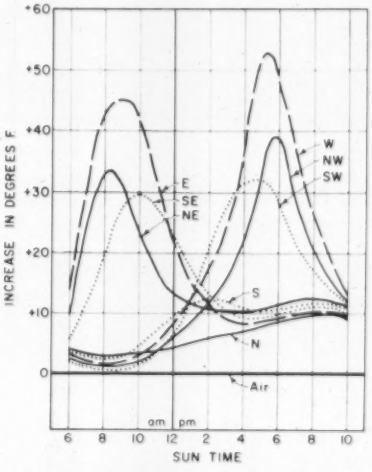


Fig. 3 — Effects of orientation. Showing the differences between the room and weather station temperatures at different glass orientations

The hours involved tend to fall during morning and evening periods where comfort is not a serious problem.

Limitations

In examining the results, certain operating characteristics of the cubicle should be kept in mind. First, heat sources are made up of conducted gains through the roof, floor, and walls, and of radiant gains through the glass. The cubicle is kept tightly closed and infiltration is negligible.

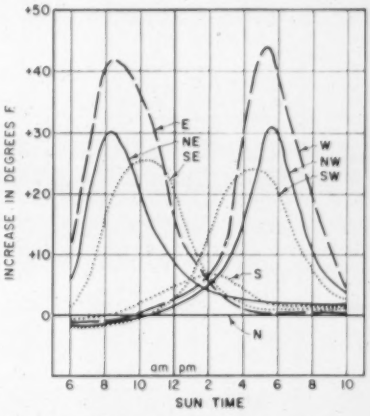


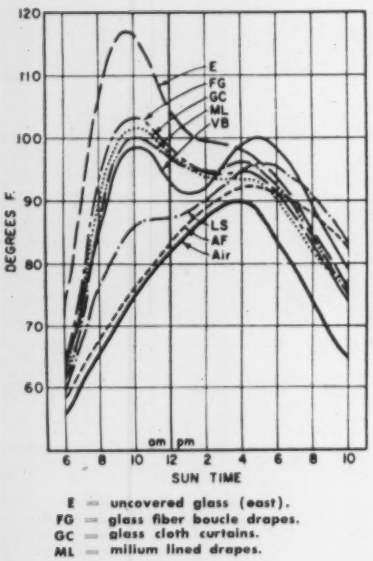
Fig. 4 — Effects of orientation. Showing the differences between room temperatures when the glass was facing north and room temperatures when it faced each of 7 other directions

Another important consideration is that the cubicle is not ventilated. Therefore, interior air temperatures indicate the magnitude of the problem which ventilation and/or mechanical cooling encounter in their efforts to produce conditions of comfort. For this reason interior air temperatures exceed exterior air temperatues during most of the day, resulting in conducted heat losses through the glass wall, through the floor to the relatively cool crawl space air below, and to some minor degree (for the most part negligible) through the north wall when cardinal orientations are being used. For this reason, also, the cooling of the cubi-

cle in the evening shows some lag which largely would be alleviated if it were ventilated generously.

The cubicle's shape deserves comment. In comparison with 1-story houses, it has proportionately greater wall surface and smaller roof surface.

In Fig. 2 the air curve represents the 1951-55 summer average air temperature previously described. Since the south readings were taken at the summer solstice the south curve represents the lowest (coolest) one which would be experienced during the summer. Its height may be expected to increase progressively during July and August.



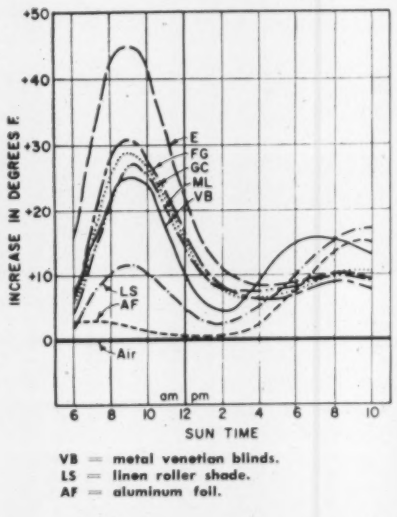


Fig. 5 *(left)* and Fig. 6. *(right)* — Effects of screening devices. Showing attempts to reduce the impact of radiation gain on cubicle room temperatures using various materials mounted inside east-facing glass

Since roof gains usually exceed wall gains this should indicate that a rectangular solid more nearly approaching the shape of an average small house would produce interior air temperatures at least as high if not somewhat in excess of those measured here.

Orientation

The cubicle was rotated at intervals to face the glass wall in 8 different directions. In addition to the 4 cardinal points, north, south, east, and west, facings of northeast, southeast, southwest, and northwest were tested. Substantial differences were observed in interior temperatures as these changes were made, as indicated on the graphs of Figs. 2, 3, and 4.

On June 21 in Davis, the morning sun is due east at about 8:15 a.m. suntime. It begins to enter the cubicle, when the glass is facing south, at 8:30 and stays until 3:30. This means that it shines through the glass for only 7 hr, at a steep vertical angle (75 deg at noon). The result is an interior air temperature curve for the morning hours only slightly higher than that produced when the glass faced westerly, and received no sun. The glass facing north produced the highest early morning temperatures, because some radiation is admitted prior to 8:00 a.m.

During the late afternon (after 4 p.m.) glass orientations from north through east to south are shaded. They cool uniformly with only the slight effects of lag differentiating between them.

One might expect the northeast curve to rise earlier than the east curve, and conversely might expect the northwest curve to drop later than that representing west. In the former case, the runs were made early in July, somewhat after the solstice, and so the sun rose about 25 deg north of east and was shaded by horizon buildings and trees until it reached a point about 20 deg north of east. By 6 a.m., when recordings began, it was about 15 deg north of east and thus more nearly normal to east-facing glass than to northeast. In the evening the cooling lag requires more time to reduce the very high west peak than the lower northwest peak. The lag more than compensates for the fact that the latter occurs about ½ hr later.

The times that the peaks occur result from combinations of the influences of radiation and convection, and of the delays caused by the insulating qualities of the construction and the specific heat of the materials. Since quantities of direct radiation which penetrate the glass when it is facing north are small, the extent to which the north curve exceeds the outside air temperature can be attributed essentially to gains conducted through the roof and through east, west, and south walls. Roof and wall temperatures during exposure to the sun (and for a cooling period thereafter) exceed air temperatures. The heat conducted through their mass is made up of radiation gains to exterior surfaces minus some surface cooling by convection.

Fig. 3 plots the outside air temperature as a flat line, or zero reading. By subtracting the air temperature from all readings, the influence of convected gain is eliminated leaving curves which are made up of radiation gains: partly against opaque surfaces stimulating conduction

through walls and roof, and partly directly through the glass wall. Again the north curve shows just the former with a roof surface and 3 walls involved. This curve could be expected to be higher were these surfaces painted black instead of white. The time distances between noon and the peaks are now the results of delays of insulation and specific heat only. The combined effect of these influences would appear to be about 2 hr.

The reverse shape of the westerly curves from 7 to 10 a.m. derives from the maximum rate of outside air temperature rise during those hours. The apparent peak in the easterly curves at 8 p.m. is caused by the tapering off of the rate of decrease of the outside air at that time. Again it should be noted that with evening ventilation the right hand portion of all curves could be lowered.

Fig. 4 shows the same glass orientations, this time plotted against a flattened-out, zero-reading north curve. Since the north curve represented radiation influences on conduction through solid walls, this item is now subtracted out along with the convected influence of the outside air previously eliminated in Fig. 3. The remaining Fig. 4 curves represent gains resulting solely from radiation through the glass wall.

The symmetry of the easterly and westerly curves is marked and seems to straddle an axis located at about 1:30 p.m. This would indicate a cooling delay, for this portion of the heat gain alone, of something like 1½ hr since the sun is symmetrical about the noon line. The peak of the south curve seems to reinforce this conclusion.

The variations in the height of the easterly and westerly curves average out evenly (east *vs.* west) suggesting that their slight differences can be attributed to the climatic idiosyncrasies of the particular days of the individual runs. The consistently thicker easterly curves, however, can perhaps be explained by the fact that easterly orientations reach their inside air temperature peaks early and are attempting to cool during the period of the day when the rise of the outside air temperature is at its maximum rate.

The westerly and south curves fall slightly below the north curve at dawn but remain slightly higher than north during the evening. This difference can probably be attributed to the cooling effects of nocturnal southerly breezes from which the north glass orientation only is completely sheltered.

Since radiation gains through easterly facing glass result from rays which begin in a horizontal position and end in a vertical position and since the reverse is true of solar incidence on west-facing glass, it might be expected that the shapes of the curves for these 2 conditions would vary with the temporal distribution of radiation quantities, even though total quantities for east and west are the same. Apparently, however, in spite of these differences in geometric relationships, the conclusion that easterly and westerly-facing glass produce equal radiant heat gains seems warranted.

Screening Devices (east)

Radiant gains through east- or west-facing glass are of about equal severity, and north and south exposures are less severe to the extent revealed in Figs. 2, 3, and 4. South, furthermore, can be alleviated by the use of overhangs. Because of the low morning and evening altitudes of the sun, overhangs are only partially effective to the east or west; vertically placed materials are the only means of completely shading openings. For the purposes of this paper the term *screening devices* is used to designate

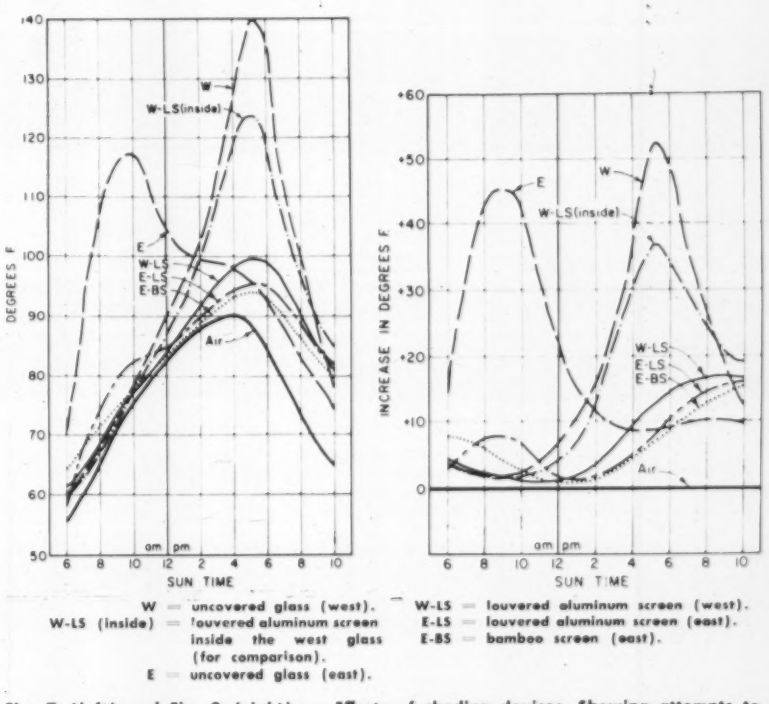


Fig. 7 *(left)* and Fig. 8 *(right)* — Effects of shading devices. Showing attempts to reduce the impact of radiation gain on cubicle room temperatures using various materials mounted outside east-facing and west-facing glass

materials covering the *inside* surface of the glass.

Figs. 5 and 6 show the results when a series of coverings were tried inside the glass surface while the glass was facing east. Again each curve represents the average condition encountered during at least 3 typical summer days, and these are plotted against the 1951-55 summer average air temperature in Fig. 5 and against the air as a horizontal line in Fig. 6. The materials used were drapes of three kinds: glass fiber boucle, sheer glass cloth, and one of moderate weight with milium lining; also stock aluminum venetian blinds; a standard linen roller shade; and a sheet of aluminum foil. The fabrics, blinds, and shade are all of light values of neutral colors, not identical in their reflective values because of manufacturer's variations, but nonetheless quite similar. The milium lining has a silvery appearance, and the foil is of natural aluminum.

The drapes were pleated and hung in folds to approximate a typical residential installation. The venetian blinds were drawn to a downward sloping position which left a space of about ¼ in. between adjacent slats and which intercepted all of the sun's rays. Both the shade and the foil were mounted flat. The thickness of the wood muntins kept all materials away from the inner surface of the glass, and left an air space between the glass and the covering material of about 3 in.

All covering materials were left mounted around the clock rather than being removed during the night. For this reason the cooling of the cubicle in the evening was retarded by virtue of the insulating effect which the covering material added to the glass. (The largest single source of heat loss of the cubicle is by conduction through the glass to the outside air.) This condition produces temperature curves which are high during evening hours and reflects physical differences among the various covering materials. For example, venetian blinds produced the highest evening temperatures probably because of their greater specific heat. They act as a *radiator* in the conventional sense in dissipating their sensible heat to the cubicle air mass. The linen shade and aluminum foil tend also to retard evening cooling, perhaps because of their relative imperviousness to air filtration as compared with the more porous and loose-fitting drapes. This latter explanation may also be the reason for the higher evening position of the drape with milium lining as compared with the unlined glass fiber and sheer types. The slight variations in relative position of the venetian blinds at dawn and the sheer curtain at dusk can probably be attributed to climatic idiosyncrasy.

The top curve represents the glass facing east with no protection. The next 3 show the 3 drapes which cluster consistently close together so that it is doubtful whether any distinction can be made among them. The venetian blind curve is slightly lower while exposed to the sun but has the disadvantage of slower cooling. Both the shade and the foil do a reasonably complete job of reflecting radiation back through the glass. The shade still retains an undesirable bulge while exposed to the sun. Were its color clear white instead of a neutral *oyster* its performance should improve. The foil is an impractical solution unless it can be mounted in a movable manner for control as in the case of blinds, shades, and drapes.

The results would seem to warrant the generalization that the materials which hang flat against the glass and which have smooth surfaces are better barriers against radiation. The smooth surface of the venetian blinds seems to be offset by the corrugated form comprising its series of slats, not unlike that of the drapes hanging in folds.

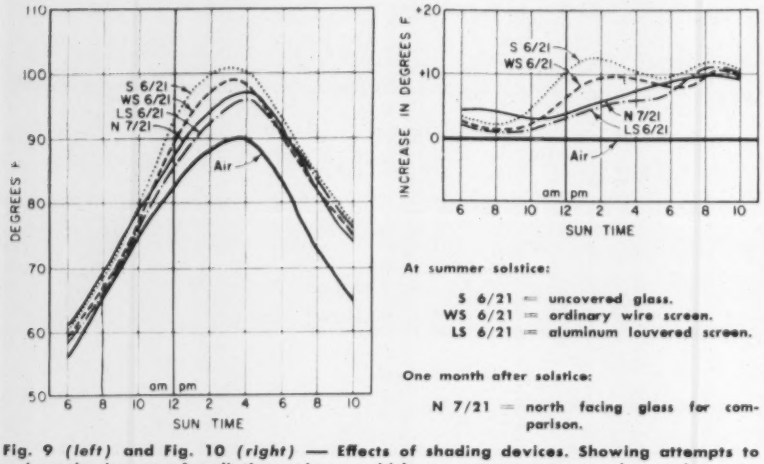


Fig. 9 *(left)* and Fig. 10 *(right)* — Effects of shading devices. Showing attempts to reduce the impact of radiation gain on cubicle room temperatures using various materials mounted outside south-facing glass

Shading Devices (east and west)

The term *shading devices* is used here to designate materials covering the *outside* surface of the glass. Results of runs where materials were mounted outside rather than inside the glass are given in Figs. 7 and 8. On the east exposure a louvered aluminum screen and a bamboo screen were used. On the west the aluminum louvered screen was repeated and was used inside the glass as well for comparison.

The morning bulge in the aluminum screen facing east indicates the small percentage of radiation which the louvers failed to shade. By comparison the bamboo was completely effective in this respect. Thus the bamboo curve stayed slightly below the aluminum screen curve during the cooling period later in the day.

A comparison of the 2 aluminum screens facing west (inside and out) underlines the importance of intercepting radiation before it strikes the glass and reaffirms the relative ineffectiveness of a *corrugated* material inside.

Shading Devices (south)

In conjunction with Figs. 2, 3, and 4 it was noted that the south data shown represent the most favorable time during the summer (the solstice), and it was also noted that further improvements are possible with shading devices.

Figs. 9 and 10 show the cubicle air temperature during the basic south exposure with the glass unprotected during the solstice compared: (1) with the outside air temperature; (2) with the use of aluminum louvered screen and ordinary wire screen outside the glass; and (3) with the glass facing north.

Ordinary wire screen accomplishes some small degree of shading at high solar altitudes but its effectiveness would doubtless decrease later in the summer with a lower sun. One might expect it to be effective hardly at all if used on an east or west exposure. On the other hand the curve representing the aluminum louvered screen can be expected to remain much as it is as the summer wears on because of the extra shading *capacity* provided by the configuration of the louvers. They are designed to keep out all summer sun. A comparison of Figs. 7, 8, 9 and 10 might suggest that aluminum louvered screen is relatively more useful east and west than on the south. Late August or early September readings, however, would probably reveal a more effective south performance than do the June readings.

It is interesting to note that glass facing south, fully shaded (as it is with the use of aluminum louvered screen) produces a somewhat cooler interior than uncovered glass facing north (assuming the south wall to be opaque and unshaded).

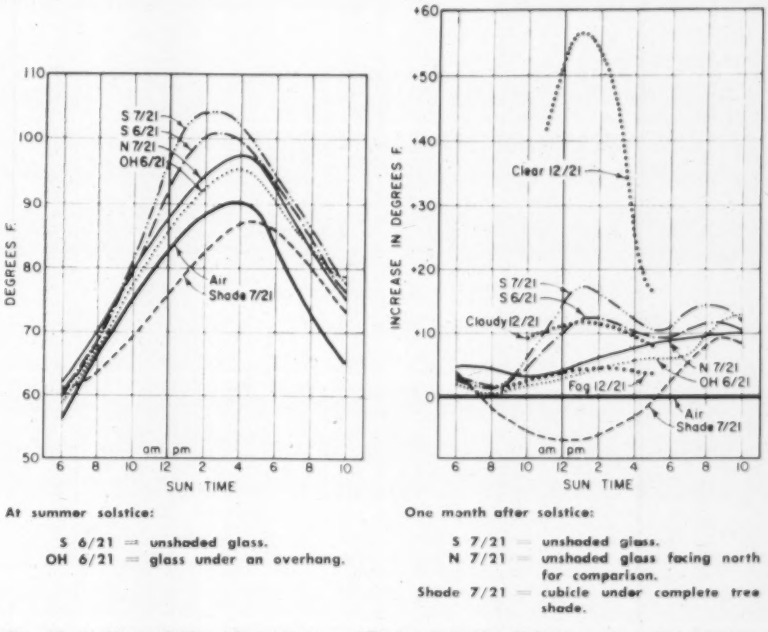
The explanation derives from the fact that in the former case cubicle radiant gain comes from a roof and 2 walls (east and west) while in the latter case it comes from a roof and 3 walls (east, west, and south).

Again, as in Figs. 7 and 8, the louvered aluminum screen curve, in relation to the others, is slightly low at dawn and slightly high during the evening. An explanation for the former may lie in the slope of the individual louvers exposing them rather well to the nocturnal sky for radiant cooling. The latter situation is probably caused by the shielding of the glass from the south cooling breezes.

Seasonal Variation and Summer Shade

Another series of runs compared curves for unprotected south glass during June and July and the winter solstice, with overhang and tree shade on south glass, and with north facing glass.

The highest summer curve represents an unshaded south glass exposure one month after the solstice (during the latter part of July). This might be considered an average summer condition since it falls somewhere near the middle of the hot weather and represents an average solar path. It is interesting to note in both Figs. 11 and 12 that the July peak temperature falls earlier in the afternoon than the solstice peak which again is earlier than the north peak. These differences are caused



At summer solstice:

S 6/21 = unshaded glass.
OH 6/21 = glass under an overhang.

One month after solstice:

S 7/21 = unshaded glass.
N 7/21 = unshaded glass facing north for comparison.
Shade 7/21 = cubicle under complete tree shade.

Fig. 11 *(left)* and Fig. 12 *(right)* — Effects of shade. Showing attempts to reduce the impact of radiation gain on cubicle room temperatures using various materials outside south-facing glass. In Fig. 12 three individual winter solstice days labeled *clear, cloudy,* and fog are added for comparison

by the fact that the north gain is virtually all conducted gain through opaque walls initiated by the radiant gains of their surfaces, while the 2 higher south curves represent progressively proportionately larger quantities of direct radiant gain through glass, producing higher inside air temperatures, with less delay and causing more rapid cooling by conduction through the glass.

Performance of a solid plywood overhang which kept out all sun during the middle of the day was also observed, and it can be seen by comparing Figs. 9 and 10 with 11 and 12 that it is about as effective as an aluminum louvered screen; slightly more effective at the peak but slightly less effective during evening cooling. The differences are small and so the overhang and the screen should be considered similar. The slight evening upturn of the overhang curve might be explained by the shelter it gives from the cold night sky and/or by the fact that relatively warm air pockets may be denied their gravitational rise and be trapped under the overhang and against the glass. Again it should be noted that shaded south glass gives better performance than does the glass facing north.

The curve representing the fully shaded condition gives an average of days when the cubicle was moved under a grove of trees with lawn covering the ground under and around it. The trees provided complete shade against the sun's rays except during brief and negligible periods at sunrise and sunset. At these times some radiation filtered through to cast spots of sunshine on the east and west walls, but for all practical purposes shade was complete.

The results produce comfortable temperatures well below the outside air as measured by the weather station thermometer in a nearby exposed location. The evening cooling lag could be alleviated by opening up the cubicle for ventilation at about 5 p.m. However, the trees may restrict access to shaded structures of some of the cooling evening breezes.

The reverse curve during early morning is a reflection of the *shading* of the cubicle roof from nocturnal radiation to the cold sky, a factor which delays cooling and constitutes a disadvantage of shaded locations. Their daytime advantages, however, seem pronounced.

Partial curves for 3 winter solstice conditions in fully exposed locations are shown for comparison with summer conditions. Each represents one day selected at random, rather than an average of 3 or more. The bottom curve shows that even during a foggy day some radiation gets through. The middle curve indicates that a somewhat larger quantity is effective on a cloudy day, and the top curve defines the substantial quantity encountered during clear weather.

Comments

This paper is in the nature of a progress report giving some of the initial results obtained from work with the cubicle. The summer work has continued and in addition, runs during fall, winter, and spring seasons have become more frequent. The recent acquisition of automatic recording equipment produces 24-hr data providing material for the study of nocturnal as well as daytime conditions. Wall and roof temperatures are being recorded and examined together with calculations comparing them with theoretically expected readings. Further structural and environmental variables are under examination.

It should be noted that these experiments are being performed in climatic conditions typical to much of the Southwest where radiation values and air temperatures are high and humidities low. Under these circumstances environmental conditions which provide shade have relatively greater effect than they would have in cloudier and more humid climates. The results given here cannot be applied in such areas without interpretation.

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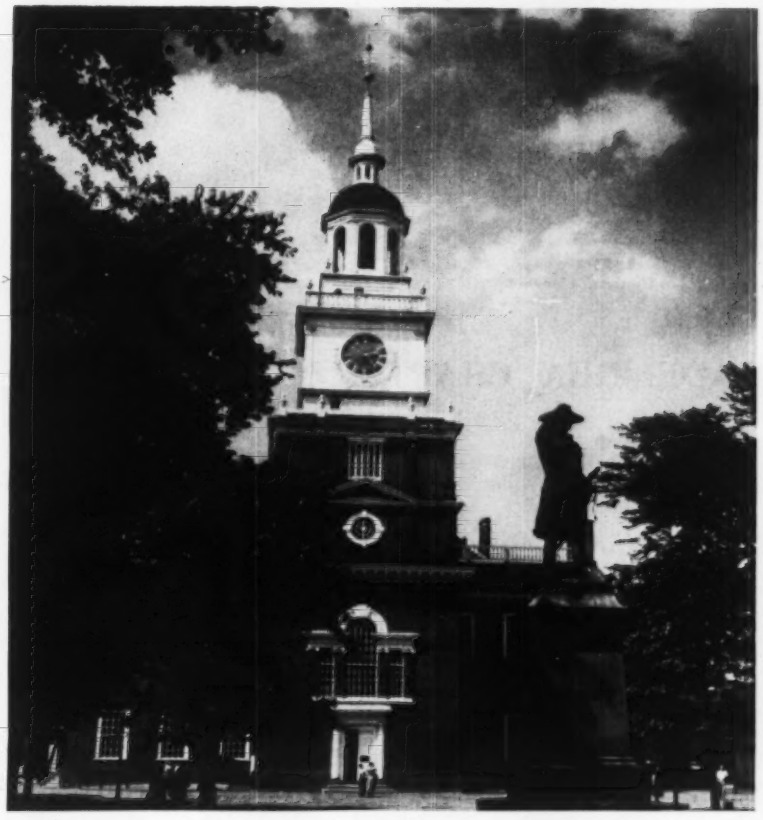
Make Plans Now for 65th Annual Meeting

Philadelphia, Pa.—January 26-29, 1959



Philadelphians Planning An Outstanding Annual Meeting

The ASHAE Program and Papers Committee with John Everetts, Jr., as chairman, and the Philadelphia Chapter Committee on Arrangements with E. K. Wagner as general chairman, have developed an outstanding program for the 65th Annual Meeting which will be held in Philadelphia January 26-29, 1959. Registration Headquarters will be located in the Bellevue-Stratford Hotel.

Although the 65th Annual Meeting officially opens on Monday, January 26, it will be preceded by various committee meetings on Saturday and Sunday. The ASHAE Registration Desk will open at 10 a.m. Sunday. At 4 p.m., there will be a *Welcome-Pennsylvania Dutch Koffee Klatch.*

The *Koffee Klatch* will be conducted by the ladies of the Philadelphia Chapter, who are planning several surprises. They also plan to have refreshments and music.

Pres. E. R. Queer, University Park, Pa., will open the 65th Annual Meeting at 9 a.m., Monday. The First Session is to be a Topical Session on Comfort, moderated by C. S. Leopold, Philadelphia Chapter.

While the men are attending this First Session there will be a ladies' bus tour of Old Philadelphia beginning at 9:30 a.m. This tour will be repeated again at 2 p.m. for those who are unable to make the morning tour.

At 12 noon the official opening of the 14th International Heating and Air Conditioning Exposition will take place at Convention Hall. At 12:15 p.m. the ASHAE *Welcome Luncheon* will be held in the Ballroom of the Bellevue-Stratford. The Honorable Richardson Dilworth, Mayor of Philadelphia, will be in attendance to officially welcome the Society to Philadelphia. The Toastmaster for the *Welcome Luncheon* will be E. K. Wagner, general chairman, and the Invocation will be delivered by P. H. Yeomans, Philadelphia Chapter.

No session is scheduled for Monday afternoon and this will give many the opportunity to inspect the over 450 exhibits which will be on display at Convention Hall. The hours for the exposition will be 12 noon until 10 p.m., Monday through Wednesday, closing on Thursday, the final day, at 6:30 p.m. Admission to Convention Hall will be by invitation and registration only; the general public will not be admitted.

The Entertainment Committee of the Committee on Arrangements, H. B. Prewitt, chairman, anticipates that everyone will enjoy the program planned for Monday evening. This will be known as a *Get-together Party* beginning at 7:30 p.m. in the Grand Ballroom of the Sheraton Hotel. It will consist of a social hour, a buffet dinner, entertainment and dancing.

First Vice Pres. A. J. Hess, Los Angeles, will call to order the Second Session at 9:30 a.m. A third Session will be opened simultaneously by 2nd Vice Pres. Walter A. Grant, Syracuse, which will be a Symposium on Hydronics moderated by P. N. Vinther, Dallas, Tex., regional director.

The Ladies Committee of the Philadelphia Chapter Committee on Arrangements with Mr. and Mrs. R. F. Buzzard as chairman and co-chairman, has scheduled a ladies' tour of historical mansions for Tuesday morning beginning at 10 a.m. Several mansions will be inspected in the morning and then the ladies will interrupt their tour to have a luncheon in the Madison Room of the Presidential Apartments.

No sessions are scheduled for Tuesday afternoon, although it is expected a number of TAC Meetings will be scheduled for that afternoon.

Four sessions are scheduled for Wednesday, January 28, with two

(continued on p. 166)

J. H. Hucker
Honorary Chairman

E. K. Wagner
General Chairman

R. P. Schoenijahn
Honorary Chairman

F. H. Buzzard
Vice-Chairman

PHILADELPHIA CHAPTER

Committee On Arrangements

65th Annual Meeting

January 26-29, 1959 **Philadelphia, Pa.**

C. J. Forve
Chapter President

BANQUET — J. J. Hucker, *Chairman*, P. R. Anderson, J. C. Benson, K. E. Clisby, L. J. Dorsey, J. R. Ellstrom, J. K. Henderson, H. N. Jacobs, H. R. James, S. J. Kowalski, Hugh Mahaffy, M. J. Wind, F. J. Zellner.

ENTERTAINMENT — H. B. Prewitt, *Chairman*, R. H. Ackermann, E. I. Curley, E. H. Dafter, F. R. Kelble, T. S. Noble, C. W. Procter, Jr., R. J. Sigel, R. H. Smiles, G. E. Tuckerman, D. A. Wicks, E. I. Wildman.

EXPOSITION — C. J. Lubking, *Chairman*, T. L. Arnold, V. R. Bitzer, I. G. Brennan, Warren Brewer, C. F. Dietz, H. W. Doerrfuss, C. J. Kern, H. K. King, A. E. Kriebel, J. F. Lowrey, H. T. Makin, Jr., H. H. Mohrfeld, C. A. Rhea, H. N. Teuber.

FINANCE — P. H. Yeomans, *Chairman*, A. C. Caldwell, W. R. Funk, A. J. Hall, Jr., J. E. Hutchison, E. C. Lambert, F. F. Pfeiffer, G. H. Johnson.

LADIES — R. F. Buzzard, *Chairman*, Mrs. R. F. Buzzard, Co-Chairman, Mmes. R. H. Ackermann, R. S. Arnold, J. C. Benson, M. F. Blankin, F. H. Buzzard, P. A. Cavanagh, E. H. Dafter, C. F. Dietz, John Everetts, Jr., C. J. Forve, J. H. Hucker, C. J. Lubking, Ludwig Mack, D. S. Plewes, H. B. Prewitt, A. M. Robertson, R. P. Schoenijahn, R. J. Sigel, E. J. Stern, E. K. Wagner, M. J. Wind, P. H. Yeomans and the Mr. and Mrs. P. R. Anderson, Isadore Director, A. H. Koch and R. M. Sharp.

PUBLICITY — Ludwig Mack, *Chairman*, G. P. Alexander, T. J. Atkins, L. A. Dickson, C. J. Moll, Morris Sheffler.

RECEPTION — P. A. Cavanagh, *Chairman*, R. S. Arnold, R. J. Augusterfer, Lucien Buck, G. F. Bertrand, C. E. Brock, Jr., C. B. Eastman, Edwin Elliott, H. H. Erickson, J. P. Hartmann, H. B. Hedges, R. F. Hunger, M. G. Kershaw, C. S. Leopold, N. W. MacNichol, W. W. Malloy, S. W. Miller, Jr., R. S. Mizener, A. G. Mutimer, H. M. Parent, Karl Rugart, W. J. Seatle, B. S. Urmston, K. W. Will, C. F. Wiltberger.

SESSIONS — A. M. Robertson, *Chairman*, R. W. Cromie, R. G. Lau, Jr., R. M. MacLean, E. G. Ramp, E. J. Stern, J. A. Zimmerman.

TRANSPORTATION — D. S. Plewes, *Chairman*, R. L. Bitzer, J. E. Copeland, L. A. Davidson, M. M. Garber, J. M. Johnston, H. V. Mount, Jr., M. J. Murray, G. W. Powell, 3rd, Edward Semel, D. J. Smith, R. B. Twining, J. A. Youtz.

WELCOME LUNCHEON — C. J. Forve, *Chairman*, W. P. Culbert, E. J. Ewald, R. M. Gillett, T. F. Kearney, S. H. Manheimer, J. W. McElgin, Stanley Stake, Leo Sudhaus.

***Top row (l. to r.):* J. J. Hucker, H. B. Prewitt, C. J. Lubking, P. H. Yeomans. *Bottom row (l. to r.):* R. F. Buzzard, Ludwig Mack, P. A. Cavanagh, A. M. Robertson, D. S. Plewes**

PROGRAM — 65TH ANNUAL MEETING

Bellevue-Stratford Hotel **January 26-29, 1959** **Philadelphia, Pa.**

(All meetings and events at Bellevue-Stratford unless indicated otherwise)

Sunday — January 25

10:00 a.m. REGISTRATION
10:00 a.m. Council Meeting
4:00 p.m. Welcome-Pennsylvania Dutch Koffee Klatch (*Burgandy Room*)

Monday — January 26

9:00 a.m. REGISTRATION
9:00 a.m. FIRST SESSION
Call to Order — Pres. E. R. Queer
TOPICAL SESSION ON COMFORT
Charles S. Leopold, *Moderator*
Researches on Heating and Ventilation in Relation to Human Comfort, by Thomas Bedford
Metabolic Patterns in Stressful Environments, by Nello Pace, M.D.
Re-evaluation of the Comfort Chart, by B. H. Jennings
9:30 a.m. Ladies' Bus Tour of Old Philadelphia
Buses leave from — Sheraton, Warwick, Bellevue-Stratford and Benjamin Franklin
12:00 noon EXPOSITION (Closes at 10:00 p.m.)
12:15 p.m. WELCOME LUNCHEON (*Ballroom*)
Toastmaster: E. K. Wagner, *General Chairman*
Invocation: P. H. Yeomans
Speaker: Hon. Richardson Dilworth, *Mayor of Philadelphia*
2:00 p.m. Ladies' Bus Tour of Old Philadelphia
Buses leave from — Sheraton, Warwick, Bellevue-Stratford and Benjamin Franklin
7:30 p.m. Get-Together Party (*Grand Ballroom-Sheraton Hotel*)
Social Hour — Buffet Dinner — Entertainment
Dancing — Howard Lanin — Orchestra

Tuesday — January 27

9:00 a.m. REGISTRATION
9:30 a.m. SECOND SESSION
Call to Order — 1st Vice Pres. A. J. Hess
Supply Outlet Locations for Basement Heating, by J. R. Wright and D. R. Bahnfleth
Pulsations in Single-Port Gas-Fired Residential Heating Equipment, by C. F. Speich and A. A. Putnam
Low Frequency Combustion Noise in Oil-Burning Equipment, by G. J. Sanders and W. E. Lawrie
Omni-Directional Low-Speed Hot-Wire Anemometer, by J. F. Kemp (by title only)
9:30 a.m. THIRD SESSION
Call to Order — 2nd Vice Pres. Walter A. Grant
SYMPOSIUM ON HYDRONICS
P. N. Vinther, *Moderator*
Design of Water Piping Systems, by B. L. Sturdevant
Noise and Vibration in Water Piping Systems, by W. L. Rogers
Selection of Pumping Equipment, by G. F. Carlson
Refrigerant Piping, by J. R. Chamberlain
10:00 a.m. Ladies' Bus Tour of Historical Mansions
Luncheon (*Madison Room, Presidential Apartments*)
Buses leave from — Sheraton, Warwick, Bellevue-Stratford and Benjamin Franklin
12:00 noon EXPOSITION (Closes at 10:00 p.m.)

Wednesday — January 28

9:00 a.m. REGISTRATION
9:30 a.m. FOURTH SESSION
Call to Order — Treas. J. H. Fox
Frost Formation and Heat Transfer on a Cylinder Surface in Humid Air Cross Flow, Parts I and II, by P. M. Chung and A. B. Algren
Downward Heat Transfer Through a Joist Space, by P. M. Chung and C. E. Lund (by title only)
Annual Energy Use for Electric Space Heating, by R. L. Boyd
Heating by Hypocaust, by E. Daisley Thatcher
9:30 a.m. FIFTH SESSION
Call to Order — Pres. E. R. Queer
SYMPOSIUM ON HEAT PUMP PERFORMANCE
G. B. Priester, *Moderator*
Performance of Water Source Heat Pump for Office Building in Southwest, by F. C. McFadden, Jr.
Performance of Water Source Heat Pump for Office Building in Northwest, by J. Donald Kroeker
Performance of Package Air Source Heat Pump Units, by W. A. Spofford
Operation of Large Air Source Central Heat Pump Systems, by E. R. Ambrose
12:00 noon EXPOSITION (Closes at 10:00 p.m.)
12:30 p.m. Ladies' Luncheon and Fashion Show (*Ballroom — Warwick Hotel*)
2:00 p.m. SIXTH SESSION
Call to Order — 1st Vice Pres. A. J. Hess
Probe for Thermal Conductivity Measurement of Dry and Moist Materials, by W. Woodside
Heat Gain through Windows Shaded by Metal Awnings, by Necati Ozisik and L. F. Schutrum
A New Method for Calculating Radiant Exchanges by Benjamin Gebhart
2:00 p.m. SEVENTH SESSION
Call to Order — Pres. E. R. Queer
SYMPOSIUM ON CORROSION AND WATER TREATMENT
W. G. Hole, *Moderator*
Water Treatment to Inhibit Corrosion, by F. Hogdon
Corrosion from Insulation, by C. E. Ernst
Hot Water and Anti-Freeze Systems, by L. D. Polderman
Specification Problems in Water Treatment, by W. L. Andrews
Taking the Mystery out of Water Treatment, by Mrs. Olivia Burkey
6:00 p.m. Social Hour (*Clover Room*)
7:15 p.m. 65th ANNUAL BANQUET (*Ballroom*)
Toastmaster: Albert J. Nesbitt
Invocation: Rev. Lewis T. Briner, Calvary Presbyterian Church, Wyncote, Pa.
Speaker: Eric A. Walker, president, The Pennsylvania State University
Introduction and Installation of 1959 Officers
Presentations
Dancing (*Rose Garden, 18th Floor*) from 10:00 p.m.
Howard Lanin — Orchesta

Thursday — January 29

10:00 a.m. Council Meeting
10:00 a.m. Auf Wiedersehen Coffee Hour (*Clover Room*)
12:00 noon EXPOSITION (Closes at 10:00 p.m.)

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(continued from p. 163)

meeting simultaneously in the morning and two in the afternoon. Treas. John H. Fox, Toronto, will preside at the Fourth Session and President Queer will call to order the Fifth Session, which is a Symposium on Heat Pump Performance, moderated by G. B. Priester, ASHAE member, Baltimore. In the afternoon 1st Vice Pres. A. J. Hess will conduct the Sixth Session and the Seventh Session will be called to order by President Queer. This last session is to be a Symposium on Corrosion and Water Treatment, moderated by W. G. Hole, Montreal, regional director, Region 7.

The final special event for the ladies will take place at 12:30 p.m. Wednesday. This will consist of a luncheon and fashion show in the Ballroom of the Warwick Hotel.

The *65th Annual Banquet* will take place at 7:15 p.m. in tthe Ballroom of the Bellevue-Stratford. It will be preceded by a social hour in the Clover Room beginning at 6 p.m. Following the Banquet there will be dancing in the Rose Garden on the 18th floor starting at 10 p.m.

The Philadelphia Chapter Committee on Arrangements felt an opportunity should be given the members to make their farewells on Thursday, and therefore are planning an *Auf Wiedersehen Coffee Hour* in the Clover Room beginning at 10 a.m. Thursday morning.

Considering the added attraction of the 14th International Heating and Air Conditioning Exposition, very large attendance is anticipated and members are urged to make hotel reservations early. It is likewise recommended that the special events reservations form be returned as soon as possible as this will assist the local Committee in finalizing their arrangements.

HONORED BY LIFE MEMBERSHIP

by recent action of Society's Council

Neil D. Adams: Rochester, Minn. « « « Has been superintendent of the Franklin Heating Station of the Mayo Clinic and the Kahler Corporation in Rochester, Minn. for almost 29 years. « « « Was graduated from Western Michigan College of Education (now Western Michigan State University). Mr. Adams taught in local high schools for the next few years, with a brief interlude in the U. S. Army. He became associated with Ellerbe and Company, St. Paul, in 1919, and soon was appointed chief engineer. He joined the Franklin Heating Station in 1929. Mr. Adams is responsible for several important inventions within the heating and ventilating field. He has known and worked with most of the pioneers in air-conditioning, heating and ventilating in the U. S. « « « From 1938 to 1940 he was a Council member of the Society. He was one of the organizers of the Minnesota Society of Professional Engineers, and was a charter member of the board of directors of the society. « « « Mr. Adams also belongs to the University Club, the Rochester Chamber of Commerce, the American Legion, the Izaak Walton League, the Elk's Club and the Knights Templar.

Lucien Buck, Philadelphia, Pa.: Designing and Sales Engineer for Proctor & Schwartz, Inc. Has specialized in dryer design and air systems for nearly 45 years and holds 13 U. S. patents on various types of industrial drying machines. « « « Has worked extensively in various positions of responsibility in Brazil including an honorary appointment by the Department of State in 1918-9. Constructed for Eastman Kodak Co., Rochester, N. Y. what was probably the first photographic raw stock paper mill built in U. S. « « « Author of a number of papers on industrial drying, manufacture of paper and leather dryers. Was Guest Lecturer on leather drying for several years at Pratt Institute, Brooklyn. « « « Born in Paris, Ky., he studied at the University of Kentucky under the renowned Dean F. Paul Anderson. He was organizer and president of the Buck Dryer Corp. which dissolved to become associated with Procter & Schwartz, Inc. « « « Joined the Society in 1928. « « « He is a 32nd degree Mason, life member of Rochester, N. Y. Consistory and an active member of *American Leather Chemists Association.*

Park S. Hedley: Buffalo, N.Y. « « « Was born in Buffalo and received his education and early training there. « « « Worked for American Radiator Co. and W. A. Case & Sons, Mfg. Co., both of Buffalo, before he became a partner in his own engineering firm. « « « Became a member of the Society and of the West New York Chapter in 1923, and was president of the Chapter in 1937.

Russell H. Heilman: Pittsburgh, Pa. « « « Has been with the Mellon Institute in Pittsburgh since 1917 where he has specialized in Heat and Vapor Transmission. He is a Senior Industrial Fellow. « « « Born in Ford City, Pa., he received his B.S., E.E. and M.E. from the University of Pittsburgh. « « « Mr. Heilman became a Society member in 1923 and has served on TAC on Insulation and TAC on Cooling Load. He has contributed to THE GUIDE and is the author of some 30 papers on Heat Transmission and Heat Insulation. He is also a member

Neil D. Adams

Lucien Buck

Park S. Hedley

Russell H. Heilman

of *ASTM Professional Engineers*, and a Life Member of *ASME*.

Arthur F. Hinrichsen: Mountain Lakes, N.J. « « « President and treasurer, Hinrichsen, Inc., New York, N.Y., which he founded in 1928. « « « Born in Newark, N.J.; attended Princeton U., where he received a C.E. and was a Phi Beta Kappa. « « « He joined the Society and the New York Chapter in 1928 and is a member of the American Society of Military Engineers, New York State Society of Professional Engineers, the Railroad and Machinery Club and other groups.

William L. Lynch: Rome, N. Y. « « « Is president of the Rome-Turney Radiator Company and director of the Farmers' National Bank and Trust Company, where he worked previous to joining Rome-Turney. « « « Born and educated in Rome, he was elected president of the Rome Chamber of Commerce in 1944. Mr. Lynch became president of the Kiwanis Club in 1940 and was chosen a member of the *Modern Pioneers* committee to attend the banquet in Rochester held in observance of the 150th anniversary of the U. S. Patent System. In 1941 he was elected a trustee of the Rome Savings Bank, and in 1942 was chosen by the *WPB* as a member of the advisory committee of the fin coil and cooler industry in their production efforts for the war. « « « He also belongs to the Elks' Club, Knights of Columbus and *ASRE*.

Erwin L. Weber: Seattle, Wash. « « « Is a consulting engineer well known in the Pacific Northwest for his work in mechanical, electrical and sanitary equipment of buildings. He was one of the pioneers in Panel Heating. « « « Born at Kassel, Germany, he received his engineering education at the University of Minnesota. « « « Joined the

Erwin L. Weber

Society in 1921. He became Vice President of the Puget Sound Chapter in 1928 and President in 1929. « « « Mr. Weber is the author of several articles on Panel Heating.

Ralph F. Winterbottom, Waterloo, Ia.: Owner and president of Heating & Cooling Supply Co., he has been active in sales and engineering since 1913. Has designed and installed heating equipment in many office and school buildings, hospitals and churches throughout the Mid-Western area. « « « Holds a patent on a unit heater and has designed and developed steam and water boilers for gas and oil fires. « « « Was born in Falls City, Nebr. and attended Business College in Kansas. « « « Joined the Society in 1923. Is a member of the *Central Supply Association, Waterloo Technical Society* and BPOE No. 190.

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ACTIVITIES OF SOCIETY CHAPTERS

Chapters have once again begun the season in full swing. Many outstanding speakers presented talks on various subjects ranging from highly technical to non-technical discussions. Speakers were enthusiastically received by the Chapters, and lively question and answer periods reflected the interest of Chapter members.

San Diego Group Receives Charter

The charter and organization meeting of the San Diego Chapter was held at Mission Valley Inn on October 15th. The chapter is the 73rd to be chartered by the Society.

Regional Director W. O. Stewart, Los Angeles, Calif.; First Vice Pres. A. J. Hess, Los Angeles, Calif.; and Pres. E. R. Queer, University Park, Pa., were all present at the meeting.

President Queer not only presented the charter to the chapter but spoke on the *Role of Chapter in* ASHAE *Operation*.

Technical Talks

Members and guests of BLUEGRASS Chapter heard I. W. Cotton of Indianapolis, Ind. explain the discomforts of *Too Much Air* in heating and air-conditioning systems • • • The highlight of the program at a CENTRAL OHIO Chapter meeting was a panel discussion on the merits of *Wet Heat vs. Dry Heat*. J. F. Wilson, sales engineer, R. A. Wilson Co., Columbus, Ohio; B. W. Cornelius, partner and mechanical engineer, Sims, Cornelius & Schooley, Columbus, Ohio; and W. R. Kinney, vice president, J. A. Myers Co., Columbus, Ohio, supported the wet heat idea. T. R. Walker, vice president, Columbus Heating & Ventilating Co., Columbus, Ohio; H. G. Hays, chief engineer, Armstrong Furnace Co., Columbus, Ohio; and A. D. Bogen, manager, The Home Furnace Co., Columbus, Ohio, upheld the dry heat theory. A very interesting question period followed and both sides rose to the occasion with excellent answers. • • • *Fan Selection and Application* was the subject of an informative talk given by J. H. McCabe, district manager, American Blower Corp., Denver, Colo., before members of EL PASO Chapter. • • • R. J. Caffrey, Sales Engineer, Johnson Service Co., New York, N. Y., was the guest speaker of the LONG ISLAND Chapter. His subject for the meeting was the transfer of temperature and humidity to central control stations. He stated the trend in the control business was to present pictorial and graphic outlines to supplant the too complicated diagrams presented to building engineers today. A lively question and answer period followed Mr. Caffrey's illustrated talk. • • • Mr. Caffrey also addressed members and guests of NEW MEXICO Chapter. His talk on *Pneumatic Control Centers* was most informative, especially in regards to pneumatic transmission which, although not new to the instrumentation industry, is relatively new to the comfort control field. A question and answer period followed. • • • NORTH TEXAS Chapter members heard an illustrated talk by Don Cousins, sales manager, Merchandising Products, The Marley Co., Kansas City, Mo. Mr. Cousins presented some interesting and basic information on cooling tower design, selection and operation. • • • R. M. Quick, assistant sales manager, Expansion Joint Division, Flexonics Corp., Maywood, Ill., spoke before members of OREGON Chapter. With slide illustrations, Mr. Quick explained the advantages of expansion joints, where they should be installed to provide the best service, and how to properly guide and anchor the expansion joint to avoid squirm, thus giving a longer life cycle to the equipment. A brief question and answer period followed. • • • *Sound Control* was the topic of a talk given by J. F. Marshall, partner, Marshall, Neil & Pauley, Inc., before members and guests of SOUTH TEXAS Chapter. At another meeting, J. A. Wheeler, manager, American Blower Corp., spoke on the subject *Sound Characteristics of Fans*. Both talks were well received by Chapter members. • • • Elliot Godes, engineer, Anemostat Corporation of America, Hartford, Conn., spoke before members of SOUTHWEST TEXAS Chapter. His subject, high velocity, involving duct design, losses and static regain, was presented in a simplified manner. All who were present enjoyed Mr. Godes instructive talk. • • • *Principles and Practices in Design of Insulated Buildings* was the topic of W. H. Smith, Jr., branch manager, Owens-Corning Fiberglas Corp., Dallas, Tex. The very interesting presentation was supplemented by slides. A brief discussion

period followed the talk which was given before members of WEST TEXAS Chapter.

Non-Technical Talks

The need for educating the customer in what could be expected in a good heating or cooling system was the theme of a talk given before members of CONNECTICUT Chapter. The speaker, C. W. Nessell, industry consultant, Minneapolis-Honeywell Regulator Co., Chicago, Ill., also discussed many of the reasons for heating and cooling systems failing to operate properly. • • • DELTA Chapter members heard T. A. Stokes, consulting mechanical engineer, Cary B. Gamble & Assocs., New Orleans, La., give an excellent presentation and discussion of the recently completed air-conditioning installations in the Civic Center's new State Office and Supreme Court Buildings, previously viewed on tour by Chapter members. • • • S. A. Gray, sales manager, Minneapolis-Honeywell Regulator Co., Dallas, Tex., spoke on *The Economics of Year-Round Air Conditioning*. The talk was thoroughly enjoyed by members and guests of EL PASO Chapter. • • • INDIANA Chapter members heard their past president I. W. Cotton of Indianapolis, Ind. discuss the importance of industrial zoning. He also explained the factors leading to the selection of such areas. The talk was enlightening and was enjoyed by all who were present. • • • Col. J. T. Sheridan, Central Air Defense Force, Richards-Gebaur Air Base, Kansas City, Mo., gave a very enlightening speech entitled *Dew Line*. Colonel Sheridan explained that this is the Distant Early Warning System used for detecting enemy aircraft and is located near the North Pole. Among the interesting facts mentioned by Colonel Sheridan in his illustrated talk before members of KANSAS CITY Chapter was that sometimes the outside temperature reaches 87 F where these radar installations are located. This created quite a problem from a heating standpoint and was solved after much detailed study by many experts in the field. • • • An excellent presentation was made on the history of the heating industry in Calgary since the turn of the century. Fred Deeves, chairman, F. Deeves & Sons Ltd., Calgary, Alta., Can., also gave the membership of SOUTHERN ALBERTA Chapter some very interesting pictures of the early construction work. Members found the talk most informative.

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OLDEST MEMBER WRITES OF HIS CAREER

Alex W. Luck, Reading, Pa., 95 on November 1st last, is by age the oldest living member of the Society. A representation from his friends and associates in the Philadelphia Chapter paid him a visit, talked over experiences, and found him well and active. In fact, found him well and active enough so that he wrote out a brief story of highlights of his long career.

A LOOK INTO THE PAST
By A. W. Luck, Life Member

I was born November 1, 1863 at Lewisham, Kent, England, where my father maintained an ironmongers shop, employing some 20 workmen on sheet metal, blacksmithing and general construction work. There was a large general work shop in the rear and from the age of 12 I spent my spare time there with the mechanics. Smithing became my hobby and I would take an old file and make a steel rod several feet long and transform it into drills, chisels, and other tools. The general knowledge I gained in my youth was a wonderful asset all through my life.

The foreman of the shop was my ideal. He schooled me in doing good work by telling me *if a thing is worth doing at all, do it right, even if it's going up a chimney or down a well — do it right.* That has been my aim all through my life in all my undertakings.

When I was a boy I would go to the Greenwich Observatory and talk with the old navy pensioners who had seen action in foreign ports. Sometimes I would row across the River Thames and board the sailing ships in the London docks. My grandfather was a captain on a sailing ship for 17 years before steam was in general use; later becoming Master of a side wheeler. All of this resulted in my starting on a voyage to Australia in 1880 when I was 17 years of age.

Hale, hearty and alert at 95, Alex W. Luck is the oldest living member of the Society

On the voyage to Australia it was planned to go around the South African Cape but after crossing the *line* the ship was becalmed in the South Atlantic. We drifted with the currents in the direction of the Inaccessible Islands located some 2500 miles from Buenos Aires, South America and 2400 miles from Cape Town. Several hours were spent off the only inhabited island, the Isle of Tristan da Cunha. The male inhabitants came to our ship in two whale boats offering in trade an unusual brand of potatoes, cabbages weighing 50 lb with 5 *hearts* on the one stem, a type of apricot, and pelican skins. The total population at that time was 20 men and one woman and they refused to leave calling it the Isle of Contentment. Today two or more cold storage plants are erected there by a South American company and the islands supply most of the demand for so-called lobster tails which are really crawfish.

The writer later introduced the brand of potatoes into Australia but did not follow it up.

In a few days over 3 months we arrived at Adelaide, South Australia, where I spent a few months. I then started west, but was not favorably impressed because of the sand, brackish water and not uncommon high temperatures of 100 to 110 F. My blacksmith training served me well providing work shoeing horses, sharpening mill picks and repairing wagon wheels. At last I arrived at Port Pirie on Spencer Gulf where only weekly railroad service was available. This would have caused several days delay so I accepted a berth on a ship sailing to Falmouth, England; signing on as an ordinary seaman.

When the ship sailed the next day I found that the captain was the only one who could converse in English as all of the crew were Swedish. In the hope of encountering favorable winds the course was around the Horn of South America. It was a rough trip, but in due time we got into the Atlantic Ocean and this time sailed close enough to St. Helena to see the picturesque harbor. It was near this island we sighted a ship we met as we left Australia. They had traveled the African course.

It took just 4 months to arrive in Falmouth, England, and I took the train from there to London; arriving home 18 months after my departure.

Shortly before my 20th birthday, in 1882, I left home again, this time for America and in a position to pay my way. I crossed the Channel to Antwerp and boarded a French steamer (converted cattle ship) bound for New Orleans. There were no cabins only rough board bunks and a few conveniences.

The immigrants were divided into companies of about 20 and one was selected as captain. Each captain handled the provisions for his group including much wine and brandy. I was selected captain of a group and this put me in the liquor business. My company consumed little wine or brandy so I used it to trade for other food and delicacies. The trip took some 12 days, with no scraps of any magnitude, and our stay in New Orleans was short as we were

Members of the Philadelphia Chapter talk with Mr. Luck about his travels which took him all the way from his birthplace in England to Australia and New Zealand. *(l. to r.)* E. K. Wagner, Mr. Luck, H. H. Erickson and H. W. Doerrfuss

soon on the train for a long rail trip to San Antonio, Tex.

San Antonio was a tough city with too many bugs and sand fleas and we were not impressed. While there I ran gas mains in the streets and put gas lines in the Alamo. I also worked as a paper-hanger in the Malvern Hotel in Alamo Plaza.

Late in 1883, we located in Galveston, Tex., which was quite a modern city built on sand. Here I secured my first papers but I was unable to obtain my final papers until 1904 as I was never in one locality long enough to qualify.

In 1884, after Galveston was inundated, I decided to go to the capital city of Austin, where I associated myself with the leading plumber. On one occasion I was assigned a job at Corpus Christi and to get there I traveled by train to Laredo (the International Bridge to Mexico being there) and from there took the narrow gage line with wood burning locomotive and two coaches. We all had to help wood-up ever 20 miles.

The job was in a house located at the top of a cliff, and I never got down to the port or city proper. However it was an event in my life in Texas.

When the job was completed I returned to Austin where I fitted up the steam cooking appliances in the New Driscol Hotel. I then worked on the State Land Office Building and was employed by the Chicago firm which had the plumbing and gas piping contract on the State Capitol Building. After completing my work in Austin they requested me to take charge of a state job in Indiana and that is how I came to be in the vicinity of Chicago in 1887, when I was with the Chicago Branch of the Detroit Heating & Light Co.

My roving disposition kept me from settling down and I opened a branch in St. Paul, Minn., for the Henderson Thermo Heaters manufactured in Reading, Pa., and the company induced me to come to the home office in Reading, Pa. I settled in Reading in 1902 and with the help of my Detroit friends I was given the right to vote in the United States.

In 1903 I became associated with the Prizer Painter Stove Heater Co., Reading, Pa. On Labor Day 1912 fire destroyed the metal patterns for boilers and the Heater Department was disbanded. With outside assistance I purchased 84 tons of heater parts and in 1913 started the Reading Heater & Supply Co.

The preservation of the historic Valley Forge, Pa., headquarters of George Washington, presented heating problems. I was asked to design a concealed heating system.

The installation is an example of gravity circulation of heated water and, in this case, the necessary air circulation for the basement and the two floors above.

When the writer first inspected the building it was so damp moisture could be wiped off the walls, the linen on the beds was moldy and the timbers in the basement were rotting. The requirements were that there should be no fire in the building, no mechanical appliances requiring electric current (as they have so many failures of power there) and no radiators, piping or anything which would destroy the historic original features of the *shrine*.

I centered my attention on the then superintendent's building which was 220 ft away with a roadway between. This determined that the flow and return pipes had to be 2 ft below the basement floor line and then go underground over 220 ft; a total of some 500 ft of main with no force but gravity and three stacks of indirects in the basement of Washington's Headquarters.

The writer introduced the vertical tank in the basement system with an 18-in. glass gage to show the air cushion and facilities for recharging.

The data on this installation were presented at one of the Society's Annual Meetings but I cannot recall the date.

I became a member of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS in 1919 and a member of the Philadelphia Chapter of the Society in 1920 and for many years held a 100 percent record for attendance at chapter meetings. In 1934 the Council elected me a Life Member. I became a member of the Engineers Club of Philadelphia in 1925 and they elected me a member of the 30-year club in 1955. In 1957 I was honored as the *Engineer of the Year* by the Reading Chapter of the *Pennsylvania So-*

Mr. Luck *(right)* and Mr. Doerrfuss chat over some of Mr. Luck's activities. For years Mr. Luck attended 100 percent of meetings of the Philadelphia Chapter, journeying from his home in Reading, Pa., to do so

JOURNAL SECTION

ciety of Professional Engineers. I have been in the Maple Farm Home Akron, Pa. since May 1955.

OFFNERS' ENJOY 'ROUND THE WORLD TRIP

Alfred J. Offner, past president of the Society and retired New York consulting engineer, is en route on an around the world trip with Mrs. Offner.

The Offners left New York on September 7 and their first stop was Los Angeles. Among the places they will visit will be Hawaii, Fiji Islands, New Zealand, Australia, Indonesia, Philippine Islands, Japan, Formosa, Hong Kong, South Vietnam, Cambodia, Thailand, Burma, India, Nepal, Ceylon, Pakistan, Iran, Iraq and Jordan.

During the Christmas Season Mr. and Mrs. Offner plan to be in Bethlehem where they will attend Christmas services at the Church of the Nativity. They will then proceed to Cairo, Aswan, Luxor, Rome, Sicily, Tunis and Morocco. The trip will be made entirely by air.

HERNDON JOINS EVANSVILLE FACULTY

C. L. Herndon, who was 1957-58 president of the Southwest Texas Chapter of ASHAE, and who has been a member of the Society for many years, has been appointed to the engineering faculty of Evansville College, Evansville, Ind. Professor Herndon left his position on the engineering faculty of San Antonio College, San Antonio, Tex., to accept his new appointment.

HEATH DIRECTOR OF ASSOCIATED INDUSTRIES

W. R. Heath, Buffalo, N. Y., ASHAE member, has been elected to the Board of Directors of Associated Industries of New York. Mr. Heath is executive vice president of Buffalo Forge Co., and is a past president of the Western New York Chapter.

TAC ON PHYSIOLOGICAL RESEARCH AND HUMAN COMFORT

The Society Technical Advisory Committee on Physiological Research and Human Comfort held a meeting in Minneapolis at the time of the Semi-Annual Meeting. It heard reports of recent work in connection with air ionization, tending to show that earlier investigations had been handicapped by inadequate instruments, and recent work would indicate that air ionization has effects on some aspects of the feeling of comfort. As a result, it was decided that the Committee members should be surveyed concerning their views on incorporating air ionization studies into the Society Research Program.

The Committee also heard reports indicating that the Laboratory test rooms for comfort studies are substantially finished and that the staff there has been augmented to permit the studies to proceed. The Committee also gave consideration to some of the material contained in THE GUIDE chapter bearing on the subject of comfort.

BAAN AT *VDI* MEETING

G. B. Baan, New York, N. Y., a member of the International Relations Committee of the Society, was designated by Pres. E. R. Queer as the official representative of the Society at the Annual Meeting of the Heating and Ventilating Section of the *German Engineers Society, Verein Deutscher Ingenieures.* The meeting was held in Stuttgart, Germany on October 16-17th.

✦ ✦ ✦ ✦ ✦

CANDIDATES FOR MEMBERSHIP

Listed here are the names of 108 men who are the candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility of receiving these candidates into membership by advising the Executive Secretary before November 29, 1958, of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted upon by the Council.

Note: **Advancement* †*Reinstatement*

Arizona (*Region* 4)

CHIRIBOGA, ALFONSO, A-C. Engr., Salt River Power District, Phoenix.

California (*Region* 4)

BATES, WILLIAM, Mgr., Co-Partner, Oceanside Heating & Ventilating Co., Oceanside.

BUCHHOLZ, F. J., Engr., Jackson & Blanc, San Diego.

BUTCHER, C. E., Sales Engr., Johnson Service Co.; San Diego.

EHMCKE, W. K., Vice-Pres. & Gen. Mgr., W. G. Ehmcke Sheet Metal Works, San Diego.

ERICSSON, C. G., Mech. Engr., Fed. Govt. 11th Naval Dist. Pub. Wks. Off., San Diego.

FRIEDRICHS, H. E., Pres., Air Conditioning, Inc., San Diego.

JACKSON, M. S., Owner-Mgr., Jackson & Blanc, San Diego.

KLEIN, K. F., Dist. Mgr., Minneapolis-Honeywell Regulator Co., San Diego.

LINBERG, E. H., Mech. Engr., Fed. Govt. 11th Naval Dist. Pub. Wks. Off., San Diego.

MCCARTHY, D. C., Sales Promotion, Tyre Bros. Paint & Glass Co., Los Angeles.

REINWALD, R. J., Sales Engr., Barber Colman Co., San Diego.

ROBERTS, J. M., Pres., Plumbing & Heating Engineering Services, Inc., San Diego.

RUFF, B. E., Sales Engr., Jackson & Blanc Heating & Air Conditioning, San Diego.

SULLAWAY, W. F., Sales Engr., Hess, Greiner & Polland, San Diego.

WHARTON, K. A., Sales Engr., The Powers Regulator Co., Los Angeles.

WILLARDSON, R. E., Asst. Secy.-Treas., E. Willardson, Inc., Los Angeles.

Connecticut (*Region* 1)

CANNER, E. M., Chief Engr., Kahn & Co., Inc., Hartford.

MAYNARD, R. J., JR., Draftsman, The Hopson & Chapin Mfg. Co., New London.

VATZ, I. P., Design Engr., E. B. Div. of General Dynamics, Groton.

Florida (*Region* 5)

PHIPPS, H. H., Mgr., A-C & Commercial Div., The Houston Corp., St. Petersburg.

Georgia (*Region* 5)

HARRISON, M. E., SR. Owner, Morris E. Harrison, Cons. Engr., Atlanta.

Illinois (*Region* 2)

BEDARD, E. J., Constr. Tech., Johnson Service Co., Peoria.

DAVIDSON, H. G., Sales Engr., Narowetz Heating & Ventilating Co., Chicago.

DVORSCEK, JOHN, Vice-Pres., Davis Construction Co., Chicago.

HOUKAL, R. J., JR., Chief Mech. & Elec. Engr., Perkins & Will, Chicago.

HUDSON, R. B., JR.*, Secy.-Treas., Air Products Equipment Co., Chicago.

KROLL, M. N., Designer, A. Epstein & Sons, Chicago.

MEREL, J. A., Secy.-Treas., United Sheet Metal Co., Chicago.

WARREN, G. H., Sales Engr., Narowetz Heating & Ventilating Co., Chicago.

WATSON, H. P., Owner, Harry P. Watson & Assoc., Chicago.

Illinois (*Region* 3)

CHICKRIS, C. H., Cons. Engr., Rock Island.

Indiana (*Region* 2)

PALMER, O. M., Mech. Engr., Fennig & Weir, Indianapolis.

Iowa (*Region* 3)

BAIN, J. R.*, Br. Mgr., Minneapolis-Honeywell Regulator Co., Des Moines.

Kansas (*Region* 3)

FOULDS, J. C., JR., Owner, Foulds Engineering Co., Wichita.

Louisiana (*Region* 6)

DUNN, R. J., Sales Engr., Richard L. Johnson, Jr., Shreveport.

ERICHSON, F. M.*, Owner, Fred M. Erichson Engineering Co., New Orleans.

LOWE, R. J., Sales Repr., Fred M. Erichson Engineering Co., New Orleans.

Massachusetts (*Region* 1)

HIRD, J. W., Treas., Oil Heating Equipment, Inc., Fall River.

KOENIG, G. F., Sales Repr., Bell & Gossett Co., Somerset.

OUELLETTE, R. A., Sales Engr., Ilg Electric Ventilating Co., Boston.

SPARKES, H. R., Engr. in charge of Supervision Installation, A. Ehrenzeller, Inc., Cons. Engr., Dorchester.

Michigan (*Region* 2)

HARTUPEE, R. B., Asst. Chief Engr., Claude B. Schneible Co., Detroit.

Missouri (*Region* 3)

JOHNSON, R. J., JR., Sales Engr., Carrier Corporation, Kansas City.

Nebraska (*Region* 3)

WESTERBERG, H. A., A-C. Sales Engr., Metropolitan Utilities District, Omaha.

WRIGHT, D. E.*, Mech. Engr., Omaha District Corps., Army Engineers, Engineering Div., Military & Design Branch, Omaha.

New Jersey (*Region* 1)

ROBINS, EDWIN, Engr.-Estimator, Stephen J. Bross, Inc., Shrewsbury.

WARSHAW, P. E., Sales Engr., The Powers Regulator Co., Springfield.

New Mexico (*Region* 6)

ELLISON, D. E., Office Mgr., J. S. Brown-E. F. Olds Plumbing & Heating Corp., Albuquerque.

MAYS, G. A., Sales Engr., The Trane Co., Albuquerque.

MERVINI, G. M., Design Engr., Dr. Marcel'o Giomi, Cons. Engr., Albuquerque.

SAWYER, L. L., Mgr., J. S. Brown-E. F. Olds Plumbing & Heating Corp., Albuquerque.

New York (*Region* 1)

CAHILL, E. M., Sales Repr., Buffalo Forge Company, Syracuse.

HANKINS, ROBERT, Mech. Engr., J. L. Ottenheimer & Assocs., Albany.

Ohio (*Region* 2)

MANN, W. H., JR., Staff Engr., The Toledo Edison Co., Toledo.

RALPH, D. S.*, Partner, Ralph & Curl, Engrs., Columbus.

ROTH, C. A., Mgr., Plbg. & Htg. Dept., Ohio Pipe & Supply Co., Cleveland.

Oklahoma (*Region* 6)

COLE, VICTOR†, Br. Sales Mgr., Carrier Corporation, Oklahoma City.

FLINSBAUGH, J. R., Sales Engr., Standard Asbestos Mfg. & Insulation Co., Oklahoma City.

JOHNSON, W. R.*, Head of Engrg. Dept., Federal Corporation, Oklahoma City.

TUMILTY, J. E.*, Mech. Engr. & Office Mgr., Wm. J. Collins, Jr., Cons. Engr., Tulsa.

VANGILDER, HAROLD, Sales Mgr. & Engr., A & A Air Conditioning Co., Inc., Tulsa.

Oregon (*Region* 4)

COLE, W. B., Br. Mgr., Htg. & A-C. Dept., Crane Co., Portland.

HINKSON, D. L., Br. Mgr., The Powers Regulator Co., Portland.

PETERSON, H. J., Chief Engr., Skidmore, Owings & Merrill, Portland.

Pennsylvania (*Region* 1)

BARGER, F. M., Mgr., Service & Installation, Minneapolis-Honeywell Regulator Co., Philadelphia.

BERGER, A. H., Gen. Sales Mgr., Burnham Corp., Berger Furnace Div., Belle Vernon.

SIEGFRIED, F. H., Br. Mgr., Tuttle & Bailey, Philadelphia.

Rhode Island (*Region* 1)

ALLEN, F. T., Treas., Gaspee Pipe & Supply Co., Inc., Providence.

ARDEN, I. L., Pres., Arden Engineering Co., Inc., East Providence.

BURKE, C. J., JR., Sales Engr., Minneapolis-Honeywell Regulator Co., East Providence.

BURT, M. S., Part Owner, R. I. Products Co., Providence.

COONEY, S. E., Piping Engr., Hartwell Co., Inc., East Providence.

DIONNE, R. A., Gen. Mgr., Hartwell Co., Inc., East Providence.

DOUGLAS, J. E., Service & Installation Mgr., Minneapolis-Honeywell Regulator Co., East Providence.

DUFFY, T. H., JR., Sales Engr., John K. MacLean Co., Providence.

EVERETT, W. C., Dept. Engr., American Moistening Co., Providence.

FITZGIBBONS, J. J., Appl. Engr., Empire State Equipment Co., Providence.

FLETCHER, P. W., Mgr., Prov. Off., Warren Webster Co., Providence.

LANDRY, C. M., Engr., Grinnell Corp. (American Moistening Div.), Providence.

LAYDEN, J. C., Refrig. Engr., Lutz Engineering Co., Inc., Providence.

LUTZ, E. A., Supvsry. Engr., Lutz Engineering Co., Inc., Providence.

MCHUGH, J. J., Sales Engr., Minneapolis-Honeywell Regulator Co., East Providence.

MCPHERSON, LEO, Service Mgr., Petroleum Heat & Power Co. of R. I., Providence.

MOORE, R. W., Treas., Enginaire, Inc., Providence.

NUTALL, N. I., Bldg. Supt. & Engr., Old Colony Co-Operative Bank, Providence.

PELOQUIN, L. E.†, Estimator, Arden Engineering Co., Inc., East Providence.

RAICHE, D. C., Engr., Designer, Charles A. Maguire & Assocs., Providence.

STOCKMAN, K. E., Pres., Aitite Engineering Co., Pawtucket.

WILEY, J. E., JR., Estimator, Carl F. Brugge Co., Pawtucket.

Texas (*Region* 6)

BEAR, G. V., JR., Repr., United Supply Co., Austin.

BERGER, R. L., Mech. Engr., Natkin & Co., Dallas.

DAVIS, J. L., Owner, Jerold L. Davis & Assocs., Cons. Engr., Houston.

HEARN, J. A., Gen. Supt., Way Engineering Co., Austin.

MARSH, R. E.†, Vice-Pres., Way Engineering Co., Austin.

PURYEAR, C. G., Plumbing & Heating Contractor, Austin.

SCHMIDT, R. E., Partner, Fox-Schmidt Plumbing Heating & Electric Co., Austin.

SHELTON, D. H., Indus. Engr., Lea County Gas Company, Ysleta.

JOURNAL SECTION

SUMMERS, G. E., Mech. Engr., General Services Administration, Dallas.

WRIGHT, B., Owner, Wright Sheet Metal Shop, Austin.

Washington (*Region* 4)

CAMPBELL, R. B.*, Sales Engr., Minneapolis-Honeywell Regulator Co., Spokane, Wash.

Wisconsin (*Region* 2)

HOCHULI, W. D., Supr. of Tech. Services, Johnson Service Co., Milwaukee.

Canada (*Region* 7)

GREEN, H. F., Vice-Pres., Flame Master, Ltd., Edmonton, Alta.

KIRBY, C. N.*, Vice Pres. & Chief Mech. Engr., J. L. Richards & Associates Ltd., Ottawa, Ont.

LAVENDER, R. J., Mech. Designer, Giffels & Vallet of Canada, Ltd., Windsor, Ont.

SCHIECK, R. R., Steam & Vtg. Engr., The Ontario Paper Co., Ltd., Thorold, Ont.

WILLIAMS, R. A.*, Sales Engr., Vet's Sheet Metal Works, Edmonton, Alta.

Iraq

HICKEY, P. L., Chief Engr., Kumait Co., Ltd., Baghdad.

OBITUARIES

JEREMIAH E. CAREY
Westfield, Mass.

Jeremiah E. Carey, president of the J. E. Carey Co., a heating and air-conditioning sales agency in Springfield, Mass., died September 18.

Mr. Carey was born in Lawrence, Mass. in 1905. After completing his education, he entered the heating and ventilating field. In 1946 he established the J. E. Carey Co.

A member of the Society since 1955, Mr. Carey held several public offices in Westfield. His efficient work as chairman of the local rationing board during World War II resulted in his commendation from local, state and national officials.

He is survived by his wife, two sons, and a sister.

ARTHUR F. BOWERS
Milwaukee, Wis.

Arthur F. Bowers, elected to Life Membership in 1949, died August 29 at his home, after an illness of six months.

Mr. Bowers was born in Akron, Ohio, and moved to Milwaukee as a child. Active in the heating industry, he was, at his death, president of the Industrial Heating & Engineering Co., Milwaukee.

A member of the Society since 1919, Mr. Bowers was also past president of the Milwaukee Association of *Heating, Piping & Air Conditioning Contractors*. He was a 32nd degree Mason, a member of the Elks club, and a member and past commodore of the Milwaukee Yacht club and the Lake Michigan Yachting association.

Mr. Bowers is survived by his widow, Dorothy K., two sons, a daughter, a sister and brother, and seven grandchildren.

JAMES J. JOYCE
Atlanta, Ga.

James J. Joyce, sales engineer with The Powers Regulator Company, Atlanta, Ga., died recently.

Born in Cleveland, Mr. Joyce completed his education in Chicago, and first worked for the City of Cleveland Public Utility Department.

He became a member of the Society in 1941.

JOHN A. NORTON
Ontario, Canada

John A. Norton, president of the J. A. Norton & Co., Ltd., Ontario, died suddenly August 27.

A graduate in engineering from the University of Toronto, Mr. Norton specialized in heating work until he opened his own consulting engineering firm in 1953.

A member of the Society since 1940, he was also a member of the *Association of Professional Engineers of Canada*.

Mr. Norton leaves his wife, Gladys, a daughter, Carol, his mother, a sister and a brother.

Committee on Research and Its Technical Advisory Committees

The research program of the Society is under the guidance of the Committee on Research — a General Committee — elected by the vote of Society membership. That Committee appoints Technical Advisory Committees as necessary and directs their activities. Listed below are the names of the current members of these committees.

Committee on Research

E. F. Snyder, Jr., Chairman — R. C. Jordan, Vice Chairman

Three Years: P. R. Achenbach, S. F. Gilman, N. B. Hutcheon, R. M. Stern, H. E. Ziel.

Two Years: D. D'Eustachio, E. S. Howarth, H. R. Limbacher, E. F. Snyder, Jr., J. I. Trimble.

One Year: Albert Giannini, F. K. Hick, M.D., R. C. Jordan, H. A. Lockhart, Arthur Nutting.

Research Executive: E. F. Snyder, Jr., Chairman; R. C. Jordan, Vice Chairman; D. D'Eustachio, N. B. Hutcheon, H. L. Lockhart.

Long-Range Research Program: R. C. Jordan, Chairman; H. A. Lockhart, Vice Chairman; N. B. Hutcheon, Arthur Nutting, J. I. Trimble.

1958 Technical Advisory Committees

Air Cleaning: W. C. L. Hemeon, Chairman; Arthur Nutting*, Vice Chairman; P. R. Achenbach, C. W. Coblentz, S. F. Duncan, O. C. Eliason, P. E. Engle, B. L. Evans, M. W. Keyes, R. C. Lower, C. H. Meyer, C. S. Stephens, J. R. Swanton, Jr.

Air Distribution: P. A. Argentieri, Chairman; H. R. Limbacher*, Vice Chairman; J. V. Berry, J. C. Davidson, F. B. Holgate, W. O. Huebner, W. W. Kennedy, W. B. Kirk, Alfred Koestel, E. J. Kurek, R. D. Madison, R. G. Nevins, H. B. Nottage, H. M. Patrick, L. R. Phillips, N. S. Shataloff, H. E. Straub, R. D. Tutt, Fred Vogt, Hrant Yousoufian.

Combustion: M. W. McRae, Chairman; H. R. Limbacher*, Vice Chairman; J. J. Boland, K. T. Davis, W. B. Kirk, D. W. Locklin, A. A. Marks, E. M. Mittendorff, W. M. Myler, Jr., C. H. Neiman, Jr., E. O. Olson, W. W. Popyk, R. W. Sage, D. L. Wooden.

Evaporative Cooling: S. F. Duncan, Chairman; R. M. Stern*, Vice Chairman; R. S. Ash, D. R. Baker, H. S. Dutcher, Leo Hungerford, L. C. Pellegrini, C. W. Pollock, C. B. Rowe, W. T. Smith, B. H. Spurlock, Jr., J. R. Watt.

Heat Pump: P. R. Achenbach*, Chairman; R. C. Jordan*, Vice Chairman; E. R. Ambrose, D. N. Berks, G. L. Biehn, Warren Cheatham, R. C. Chewning, S. F. Graziano, G. C. Hall, W. L. McGrath, W. E. Nanes, W. O. Stewart.

Heat Transfer Through Fenestration: D. D'Eustachio*, Chairman; R. C. Jordan*, Vice Chairman; T. C. Carson, O. D. Englehart, W. B. Ewing, C. W. Kelly, J. B. Leavy, E. C. Miles, Bruno Morabito, F. W. Mowrey, G. R. Munger, O. L. Pierson, D. J. Vild, O. F. Wenzler, C. J. Youngblood.

*Member of Committee on Research.

Heating and Air Conditioning Loads: H. T. Gilkey, Chairman; P. R. Achenbach*, Vice Chairman; R. T. Baum, R. G. Chapman, C. W. Coblentz, R. A. Gonzalez, W. G. Kane, T. C. Min, G. R. Munger, I. A. Naman, T. F. Rockwell, A. M. Simpson, D. B. Turkington, A. Grant Wilson, W. R. Yeary.

Hot Water and Steam Heating: A. O. Roche, Jr., Chairman; H. E. Ziel*, Vice Chairman; G. F. Carlson, J. R. Carroll, J. W. James, D. L. Lindsay, R. B. Luhnow, Jr., E. M. Mittendorff, J. D. Pierce, K. O. Schlentner, L. E. Seeley, G. E. Olsen, R. M. Stern*, E. R. Teske, N. E. Westphal.

Industrial Environment: Arthur Nutting*, Chairman; J. H. Clarke, Vice Chairman; Lucien Brouha, F. N. Calhoon, K. J. Caplan, C. S. Cave, A. S. Gates, Jr., Robert Greenwald, T. F. Hatch, E. C. Hungate, J. M. Kane, H. P. Kaulfuss, R. L. Kuehner, B. R. Small, R. P. Warren.

Insulation: G. R. Munger, Chairman; H. A. Lockhart*, Vice Chairman; J. M. Barnhart, W. J. Binder, H. C. Brown, Jr., C. W. Foster, D. A. Huebner, W. T. Irwin, F. A. Joy, R. A. LaCrosse, R. J. O'Heir, F. E. Parsons, E. L. Perrine, C. F. Pridmore, K. M. Richie, Laurence Shuman, W. C. Turner, J. D. Ueber.

Odors: H. L. Barnebey, Chairman; J. I. Trimble*, Vice Chairman; C. J. D'Angio, C. F. Kayan, R. L. Kuehner, E. H. Lindemann, Lawrence Macrow, Douglas E. Melzard, P. J. Messer, Sherman Ross, S. B. Smith, L. A. Staebler, R. D. Touton, Warren Viessman.

Plant and Animal Husbandry: H. A. Lockhart*, Chairman; T. E. Bond, M. K. Fahnestock, A. J. Hess, C. F. Kelly, G. L. Nelson, R. E. Stewart, H. J. Thompson, H. E. Ziel*.

Physiological Research and Human Comfort: John Everetts, Jr., Chairman; F. K. Hick*, M.D., Vice Chairman; Thomas Bedford, H. S. Belding, Lucien Brouha, M. K. Fahnestock, T. F. Hatch, L. N. Hunter, N. B. Hutcheon*, John W. James, P. J. Marschall, R. G. Nevins, L. J. Pecora, P. W. Wyckoff, C. P. Yaglou.

Solar Energy Utilization: R. C. Jordan*, Chairman; M. L. Ghai, Vice Chairman; E. R. Ambrose, F. R. Ellenberger, H. C. Hottel, N. B. Hutcheon*, M. L. Khanna, G. O. G. Löf, Gunnar Pleijel, Maria Telkes, J. L. Threlkeld, G. T. Ward, L. F. Yissar.

Sorption: G. C. F. Asker, Chairman; E. S. Howarth*, Vice Chairman; H. L. Barnebey, W. P. Cummings, W. E. Emley, Jr., R. J. Getty, R. R. Goll, T. E. Gravenstreter, Anthony Hass, G. A. Kelley, E. R. McLaughlin, R. M. Milton, H. E. Parker, W. L. Ross, G. L. Simpson, G. T. Ward.

Sound and Vibration Control: A. F. Hubbard, Chairman; D. D'Eustachio*, Vice Chairman; C. M. Ashley, Sydney Baken, J. B. Chaddock, R. A. Gerlitz, J. B. Graham, R. N. Hamme, John Harker, C. R. Hiers, F. B. Holgate, F. D. Joesting, D. H. Krans, R. D. Lemmerman, R. E. Parker, G. J. Sanders, R. M. Towne, R. J. Wells.

Thermal Circuits: S. F. Gilman*, Chairman; Harry Buchberg, Vice Chairman; N. R. Gay, C. F. Kayan, C. B. Monk, Jr., L. W. Nelson, H. B. Nottage, K. R. Solvason, P. H. Yeomans.

Weather Data: W. L. Holladay, Chairman; P. R. Achenbach*, Vice Chairman; James Bricker, D. T. Donovan, John Everetts, Jr., D. L. Fiske, J. B. Graham, W. S. Harris, W. J. Radle, W. T. Smith, H. C. S. Thom.

Society Organization Personnel

General Committees: The By-Laws provide for 9 such committees. The latest list appears in the July 1958 issue on page 148

Research Committees: The research program is under the guidance of the Committee on Research — a General Committee. The Committee on Research (see above) appoints Technical Advisory Committees as needed. The 1958 personnel appear above.

Special Committees: At present there are 9 of these committees. The latest listing appears in the July 1958 issue on page 148

Standards Committee: Its subcommittees and its representatives appear in the August 1958 issue on page 166

Nominating Committee: This committee's membership is fixed by the By-Laws. The latest listing appears in the July 1958 issue on page .. 148

Society Regional Organization: The 1958 listing of the names of the Regional Directors and of the members of the Chapters Regional Committees was published in the May 1958 issue on page 194

Society Chapters and Branches: The Society has chartered 73 Chapters, 1 Overseas Branch and 6 Student Branches. These groups elect their officers and governing boards. A list of the presidents and secretaries appears in the October issue on page .. 145

Remove Condensate and Air without STEAM LOSS with

HOFFMAN STEAM TRAPS

Guardian of your Fuel and Comfort

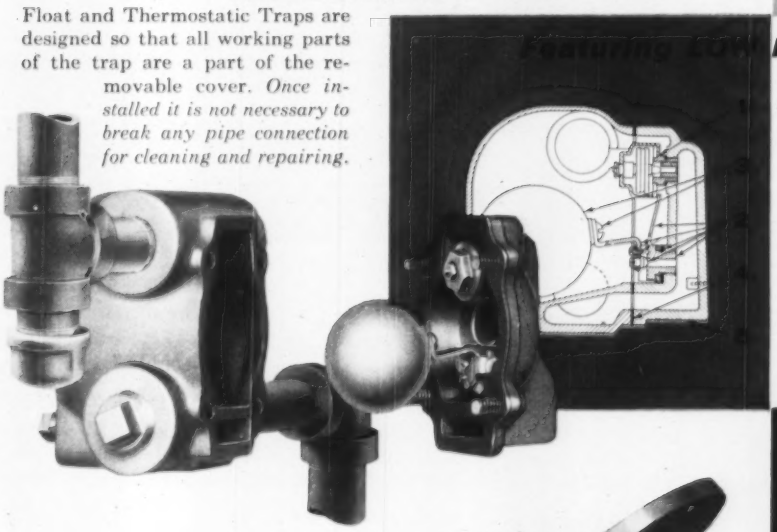
Hoffman Traps incorporate design features which assure both effective *and* economical removal of condensate from steam lines and equipment. Typical of Hoffman's complete line are the Traps illustrated, each with removable cover, pin and seat for quick inspection and cleaning.

LOW, MEDIUM and HIGH PRESSURE THERMOSTATIC TRAPS with RENEWABLE THERMOSTATS and VALVE SEATS

A complete line of Low, Medium and High Pressure Thermostatic Traps for service with radiation, dryers, sterilizers, mangles, cookers and similar uses. *Renewable thermostats and seats are important constructional features contributing to long life and low cost service.* Medium and High Pressure Traps have stainless steel pins and renewable seats.

50 SERIES F & T TRAP

Float and Thermostatic Traps are designed so that all working parts of the trap are a part of the removable cover. *Once installed it is not necessary to break any pipe connection for cleaning and repairing.*

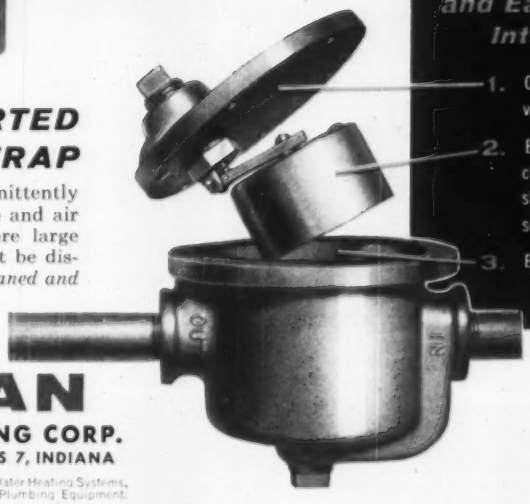


MAINTENANCE COST

1. Complete Thermostat Assembly
2. Durable, accurately machined Valve Lever and Seat Assembly
3. Copper Float Ball Assembly
4. Graphite Impregnated Asbestos Gasket
5. Heavy Duty Cast Iron Cover

600 SERIES INVERTED BUCKET TRAP

Hoffman Bucket Traps operate intermittently and are ideal for draining condensate and air from steam lines or equipment where large quantities of air and condensate must be discharged. *They are easily inspected, cleaned and serviced by merely removing the cover.*



Highly Efficient and Easily Accessible Interior Design

1. Cover with plug, stainless steel valve seat and holder.
2. Bucket and valve assembly including lever, fulcrum pin, valve, stainless steel pin, bucket, cap screw, locknut and washer.
3. Body with gasket and drain plug.

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SPECIALTY MANUFACTURING CORP.
1700 WEST 10th STREET, INDIANAPOLIS 7, INDIANA

Valves, Traps, Vacuum and Condensation Pumps, Forbed Hot Water Heating Systems, stocked and sold by leading Wholesalers of Heating and Plumbing Equipment.

For full particulars, write for catalogs on Bucket Traps, Float and Thermostatic Traps or Thermostatic Traps.

no more knuckle-busting . . .

New RIDGID No. 450 Portable Tristand Chain Vise

has Large Easy-to-Operate Top Screw Handle right up on top

Capacity, ⅛" to 5"
Weight, 42½ Lbs.

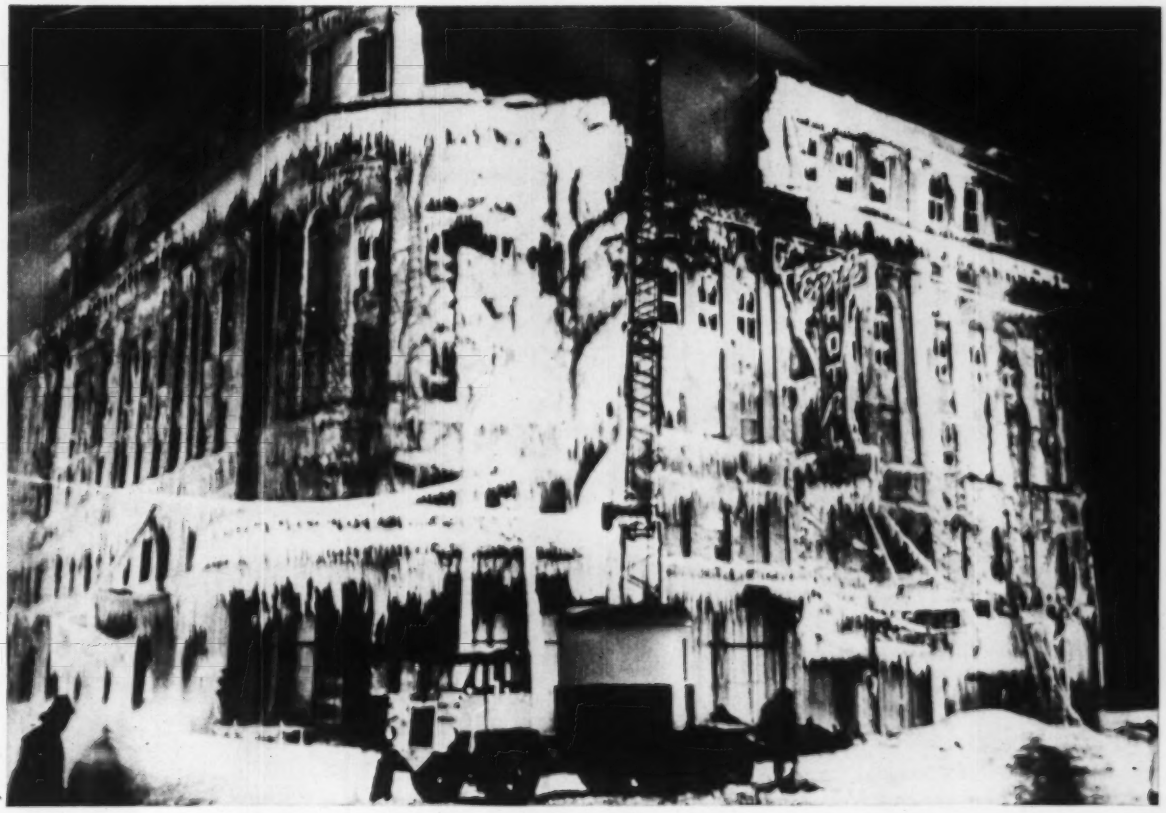
Here's a real time saver. Not only do you get a complete work-bench that's truly portable, but now you get a chain vise that's extra easy and fast to operate. Handle is right up on top where it's always handy. Handle and tightening nut are anchored to vise base . . . can't pull out.

Vise base, that overhangs front legs for clear tool swing, has hanger slots for tools, 3-size pipe bender, rear pipe rest and adjustable ceiling brace screw. Folding legs and integral tray set up easily and lock in position for rigid work base. Snap chain holds folded legs closed for easy carrying . . . no loose parts. Rubber grommets in tristand feet prevent creeping. See and try this more-for-your-money RIDGID Top Screw Chain Vise at your Supply House!

New RIDGID Bench Chain Vises have same Extra-Efficient Top-Screw Adjustment . . .

5 Sizes, for ⅛" to 8" Pipe, Conduit or Rod

The Ridge Tool Company • Elyria, Ohio • U. S. A.



A STEEL PIPE FIRE SPRINKLER SYSTEM COULD HAVE PREVENTED THIS

Many of the disastrous fires which cause billions of dollars of annual loss and snuff out many hundreds of lives could be prevented if all buildings were equipped with *steel pipe* fire sprinkler systems.

The cost of a *steel pipe* sprinkler system when related to the potential loss factor is truly insignificant . . . and the savings in insurance premiums alone are considerable.

For fire sprinkler systems *steel pipe* is the accepted transmission medium to carry the flame-extinguishing water. This has always been the case, for *steel pipe* is the least expensive and most versatile of all metal tubular products.

That's why *steel pipe* is the most widely used pipe in the world, for fire sprinkler systems, radiant heating, snow melting, vent and drainage lines, electrical conduit, structural uses, gas, oil and steam lines.

Typical of modern *steel pipe* fire sprinkler systems is this one in the ceilings of the nation's largest single banking room in Houston, Texas.

STEEL PIPE IS FIRST CHOICE

- Low cost with durability
- Strength unexcelled for safety
- Formable—bends readily
- Weldable—easily, strongly
- Threads smoothly, cleanly
- Sound joints, welded or coupled
- Grades, finishes for all purposes
- Available everywhere from stock

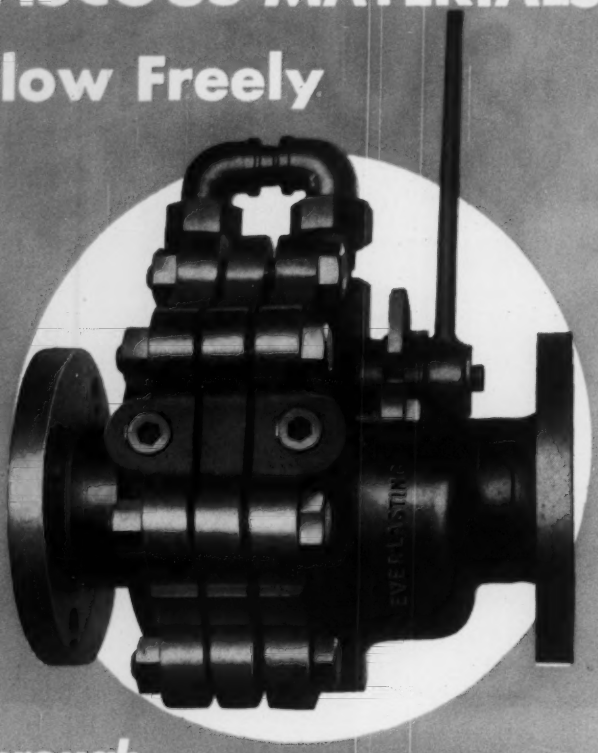
INSIST ON PIPE MADE IN U.S.A.

COMMITTEE ON STEEL PIPE RESEARCH

AMERICAN IRON AND STEEL INSTITUTE

150 East Forty-Second Street, New York 17, N.Y.

VISCOUS MATERIALS Flow Freely



through

Steam-Jacketed EVERLASTING Valves

The EVERLASTING Steam-Jacketed Valve has proven outstandingly successful in handling many different kinds of viscous materials, such as tar, asphalt, pitch, paraffin, waxes, molten sulfur, etc.

Available in sizes 1½ in. to 6 in. inclusive, in iron body for 125 psi and cast steel for 150 psi.

For further details, write for Bulletin E-200.

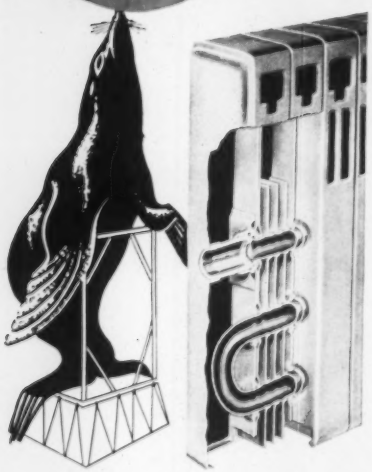
For "everlasting" service, use

EVERLASTING *Valves*

EVERLASTING VALVE CO.
61 FISK STREET, JERSEY CITY 5, N. J.

EV390

ONLY SHAW radiators deliver radiant and convected heat Properly Balanced



Shaw Panel Radiators distribute a carefully engineered combination of radiant and convected heat that only Nature, at her best, can rival.

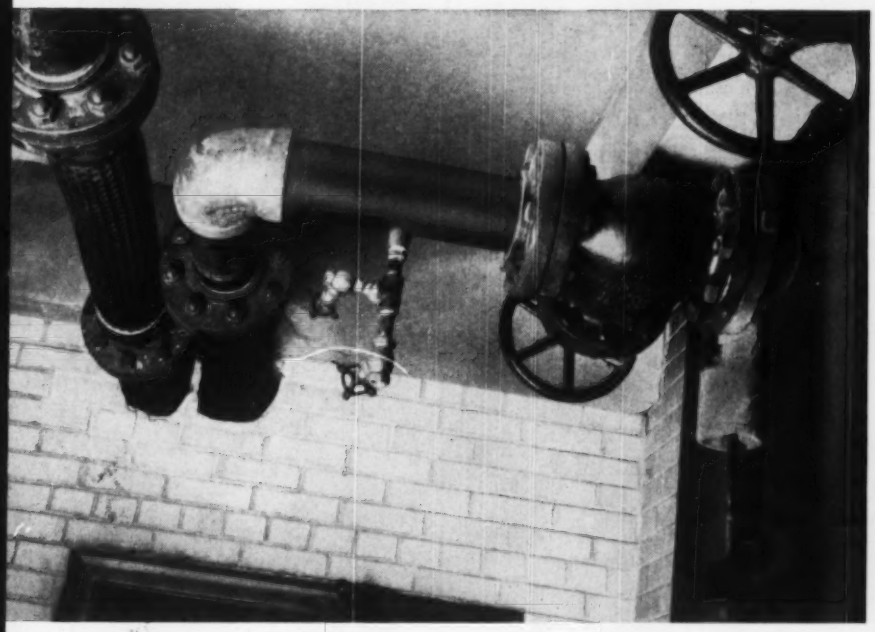
Shaw's health-guarding proportions of radiant and convected heat will not vary regardless of hot water or steam temperature. There is no stratification – heat is distributed evenly throughout the room.

Investigate Shaw Panel Radiators. They are rugged, self-contained steel and copper units, of one-piece-bonded construction, easy to handle and install. Heights are 8" to 26"; lengths 11" to 111". Choice of same end or opposite end tapping on all models facilitates piping economies and proper radiator location. Write today for full information.

SHAW-PERKINS
MANUFACTURING COMPANY
201 East Carson St. • Pittsburgh, Pa.

APPLICATION HINTS:

Ways to simplify construction and cut costs with Flexpipe



Flexpipe helps meet tough piping problem in air conditioning an existing building

THE PROBLEM: Air conditioning an existing office building usually calls for a bit of ingenuity in design. One large New York office building decided to air condition by making provision for packaged, water-cooled units to be installed on any floor as tenants required.

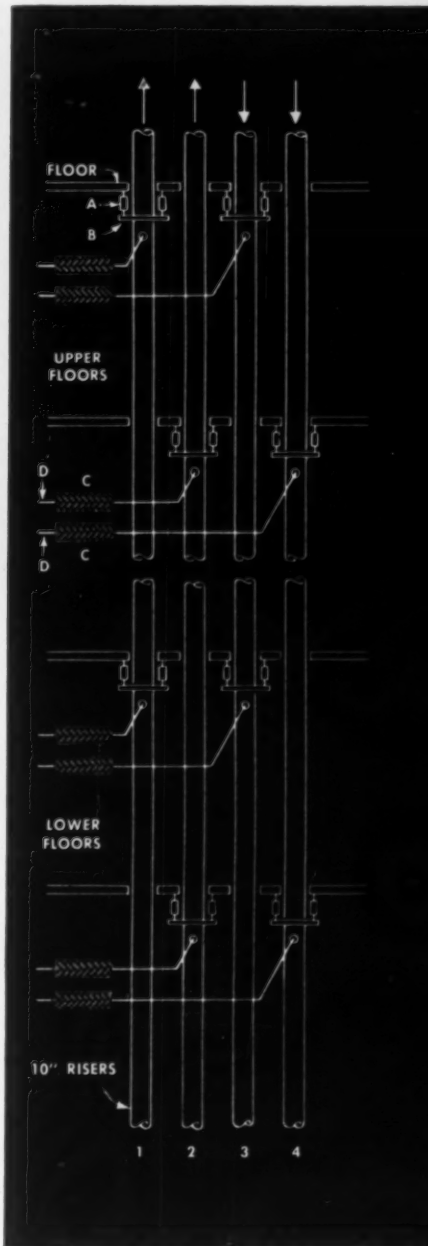
This called for four 10-inch risers, running the height of the building, to carry cooling water between the cooling tower and the branch pipes at each floor level. Because of structural conditions, the risers could not be run down through the basements and supported from below. The combined weight of pipes and the water was so great that they could not be anchored at any one point on the structure.

So the consulting engineers, Zimmermann Engineering, New York, floated the risers on spring hangers, distributing the weight evenly over all floors. This meant, however, that the risers were free to move. A riser full of water weighs several tons more than an empty one and settles about two inches.

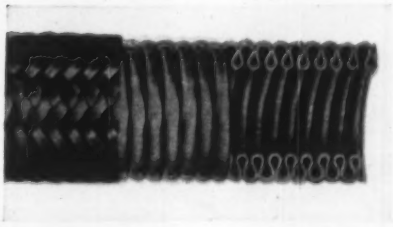
Therefore connections between risers and branch pipes had to be flexible. They also had to have strength, because water pressure at the lower floors approaches 400 psi.

THE SOLUTION: Flexpipe connectors were the answer. They provided the flexibility and the strength required. Furthermore, they were available in the sizes needed —from 5″ diameter at the lower floors to 2″ at the top floors.

WHERE TO BUY: Flexpipe connectors come in convenient standard sizes and are sold by leading distributors. They can show you samples and answer questions about service applications. For the name and address of the one serving your area, or for more detailed information, write to: The American Brass Company, American Metal Hose Division, Waterbury 20, Conn. In Canada: Anaconda American Brass Limited, New Toronto, Ont. 58226



SCHEMATIC DIAGRAM showing how cooling-water risers were installed. A: spring hangers. B: pipe clamps. C: Flexpipes. D: branch pipes at each floor. 1, 2, 3, and 4: risers, 10 inches in diameter. *Upper left:* Photo of Flexpipe installation at a lower floor.



FLEXPIPE'S flexible core can be either tin bronze, hot dipped galvanized steel or stainless steel. End fittings (attached): flanges, threaded males and welding nipples.

Flexpipe® an **ANACONDA®** product

made by The American Metal Hose Division
of The American Brass Company

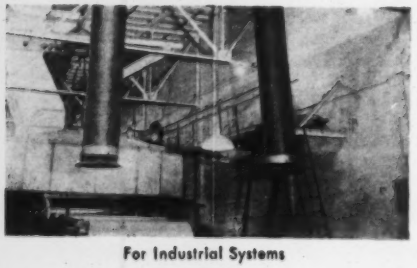
here's how you can

BID LOWER

by cutting your duct cost!

For Residential Systems

For Commercial Systems



For Industrial Systems

1662

Figure your next estimate based on using

SONOCO SONOAIRDUCT® FIBRE DUCT

In slab perimeter heating or combination heating and cooling systems!

You'll be able to bid lower without lowering construction quality, because SONOAIRDUCT saves you installation time, labor and money! It handles easy, levels quickly. Aluminum foil lined. 23 sizes—2" to 36" I.D., in standard shipping lengths of 18'. Other lengths available, which can be sawed on the job. The larger diameters are ideal for commercial and industrial heating and cooling where duct is encased in concrete. Meets and exceeds F.H.A. criteria and test requirements for this type product. Free installation manual. See our catalog in Sweet's.

For complete information and prices, write

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Construction Products

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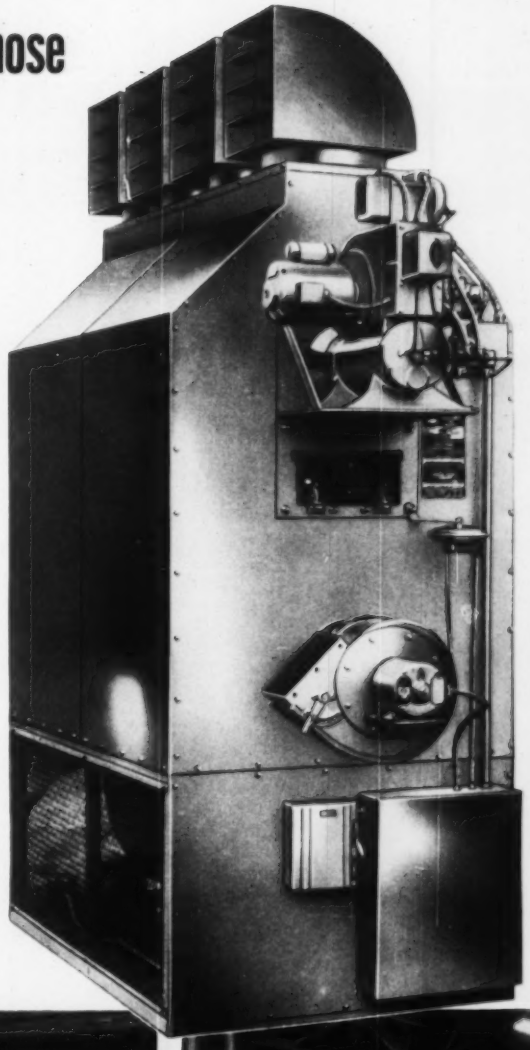
Specify LENNOX for those BIG heating jobs!

FROM THE WORLD LEADER IN WARM AIR HEATING COMES THIS NEW FIELD-PROVED INDUSTRIAL HEATER . . . 400,000 to 2,000,000 Btu/h

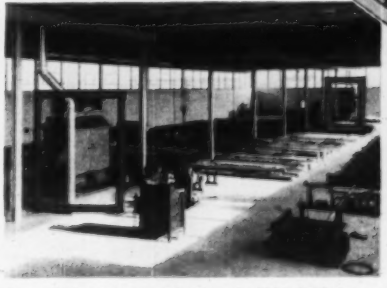


Installation flexibility; that's the Lennox "AT" series industrial heater. No task too large or small—designed for space heating, make-up air, drying or oven application—with your option of floor, horizontal or inverted units. And you can use oil, gas or combination fuel. In every installation Lennox engineering produces *exceptional* efficiency. Here are just a few of the reasons:

- ***4-pass counter flow design*—gets more heat from the flame (no internal baffles).**
- ***Double casing with metal radiation shield*—provides insulating curtain of air to hold DOWN cabinet heat losses.**
- ***Stainless steel combustion chamber*—prevents failure due to unrelieved stress. Warranted for 10 years!**
- ***One master controller. . .*eliminates non-standard, hard-to-replace control system components.**

Send for complete engineering data and specifications; see for yourself why plant engineers the country over are specifying Lennox "AT" series heaters!

One of four Lennox gas-fired heaters at C. A. Roberts Company, Detroit mfr. of steel tubing. Mounted at ceiling height, this space saving 500,000 Btu/h heater is tailored to the job.



Two oil-fired Lennox heaters in Wheelock-Lovejoy's steel warehouse (Centerline, Mich.) provide warm air heating for 20,000 sq. ft. Units are 750,000 and 1,000,000 Btu/h capacity.

Five gas-fired Lennox heaters at Wm. Montgomery Co. warehouse, King of Prussia, Pa. Fresh air introduced by heaters replaces the truck-exhaust foul air.

LENNOX Industries Inc.

INDUSTRIAL DIVISION

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LENNOX INDUSTRIES INC.
Industrial Division, Dept. HP-11
1701 East Euclid, Des Moines, Ia.

Please send me—without obligation—complete specifications and engineering data on Lennox AT series Industrial Heaters.

Name_____

Company_____

Address_____ City_____

Title_____

Field reports about AIR CONDITIONING

Successful installations using Freon refrigerants*

1,200-ton package unit system comfort-cools the Dallas Home Furnishings Mart

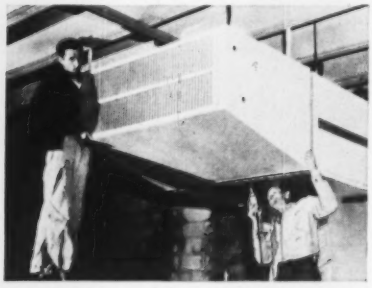
General Electric Packaged Units, ranging in size from three to seven and a half tons, provided the key to flexibility at the 1,200-ton Dallas Home Furnishings Mart installation. Each General Electric Unit contains a sealed refrigerating system for cooling; a blower, and heating coils connected to an outside source of warm water. These units are suspended from the ceiling, saving valuable sales and display space, and they are easy to install by simply connecting up the electricity and piping.

Condensers for all 222 packaged units are cooled with water from a central cooling tower. Roof-mounted fans deliver fresh air to concealed ducts for distribution to display areas. Another set of fans exhausts air through relief grilles near the ceiling along hallway and courtyard areas.

Tenants and owners alike report a high degree of satisfaction with the General Electric Packaged Unit system. If *flexibility* is your problem, why not consider this type of system?

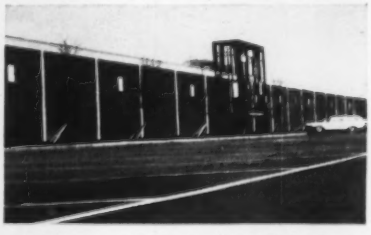
222 package units satisfy conflicting cooling needs at Dallas Mart

How do you satisfy a wide range of varying cooling loads in a large building? Texas Distributors, Inc., came up with a practical answer for the Dallas Home Furnishings Mart, where furniture buyers throughout the nation make large semi-annual purchases in Dallas, Texas. The job called for cooling 434,000 sq. ft. of display space, where largest tenant area was ten times as wide as the smallest and some areas were twice as deep as others. And the building was designed with movable,



semi-permanent walls, so tenant areas would often change in size *after* the air conditioning system was installed. Comfort cooling was critical in all areas.

After careful study, Texas Distributors decided on General Electric Packaged Units. These units provide maximum flexibility in cooling and enable each tenant to pay only for the air conditioning he uses. A total of 222 General Electric Packaged Units were used in the system described at the left.



• Outside view of Dallas Home Furnishings Mart, where 222 General Electric Packaged Units were installed.

For dependable performance, specify "Freon" premium quality refrigerants

Why take chances on refrigerants that are supposed to be "just as good" when it doesn't cost you a penny more to buy "Freon"—the original, *time-tested*, safe refrigerant? "Freon" is a product of Du Pont research, backed up by more than a quarter of a century of experience in the manufacture of safe, dependable refrigerants. So insist on "Freon" and enjoy the benefits of its trouble-free performance.

For complete information on applications, performance and properties of "Freon", write: *E. I. du Pont de Nemours & Co. (Inc.), "Freon" Products Division 1311 Wilmington 98, Delaware.*

SALES AGENTS: Ansul Chemical Co., Marinette, Wisconsin; and Virginia Smelting Co., West Norfolk, Virginia

FREON® *premium quality* **refrigerants**

**Freon and combinations of Freon- or F- followed by numerals are Du Pont's registered trademarks for its fluorinated hydrocarbon refrigerants.*

DU PONT
REG. U.S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

NEW... from K&M

EXTERNAL PILOT-OPERATED PRESSURE REGULATOR

fast-acting, accurate . . . tight shut-off even on dead-end service

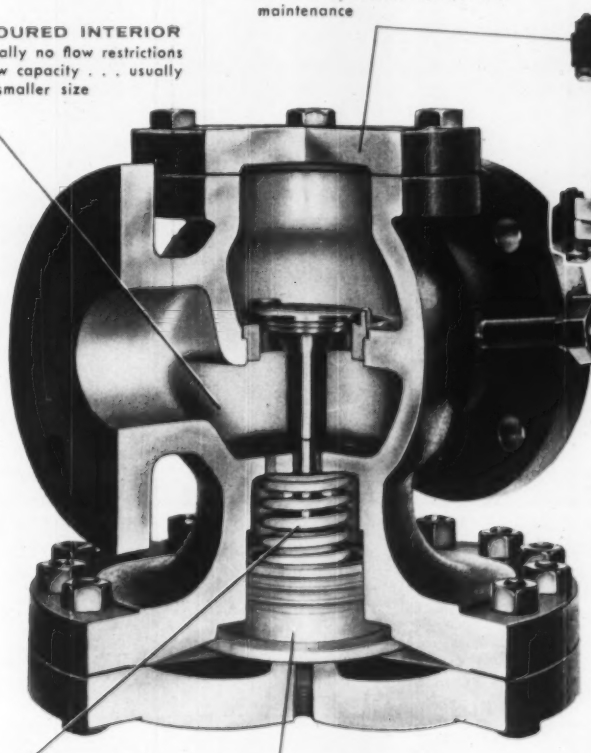
Examine it yourself . . . feature for feature. K&M has made a vast improvement in external pilot-operated pressure regulators.

It simplifies installations: *requires one less pipe line.* It offers lowest maintenance: *the result of good hydraulic and mechanical design throughout.* It gives excellent performance: *try one and compare with any other regulator of its type.*

BUILT-IN STRAINER
protects pilot from scale, dirt, other foreign matter, is removable for cleaning

BLIND FLANGES
on both main valve and pilot allow easy access for routine maintenance

CLEANLY CONTOURED INTERIOR
has no spider, practically no flow restrictions . . . gives greater flow capacity . . . usually permits economy of smaller size



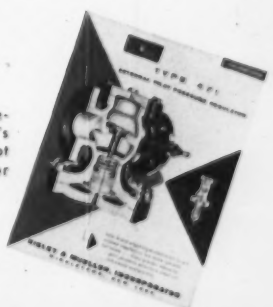
INTEGRAL BLEED ORIFICE
eliminates need for installation of extra bleed line

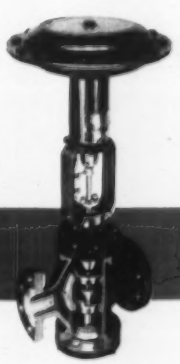
PRESSURE-ADJUSTING SCREW
permits convenient external pressure setting

GUIDE PISTON
has balancing grooves which hydraulically center guide, prevent binding and side-thrust

CONTROL SPRING
is isolated from main flow stream for greatest protection

If you would like a more detailed, close-up look at K & M's new Type 471 External Pilot Pressure Regulator, send for Bulletin 471A.





K&M

diaphragm control valves

Our 79th Year

KIELEY & MUELLER, INCORPORATED

Oldest Pressure and Level Control Valve Manufacturer
64 Genung Street, Middletown, New York

S.A. 1808

A new type of Industrial smokestack by Van-Packer

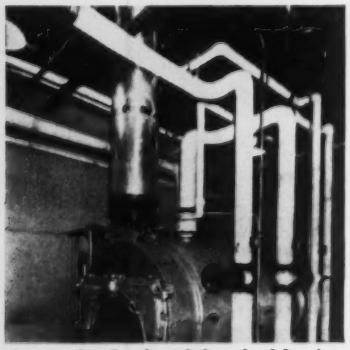
Outlasts steel stacks, costs no more

Won't corrode — The Van-Packer industrial smokestack is made of centrifugally-cast 3-foot refractory sections that will far outlast a steel stack. An aluminum jacket encases each section and eliminates maintenance.

Economical — The Van-Packer costs no more than a steel stack; 2/3rds less than a brick stack. Easy installation, savings on maintenance, and long life results in further savings. Provides high draft equal to that of a comparable brick stack.

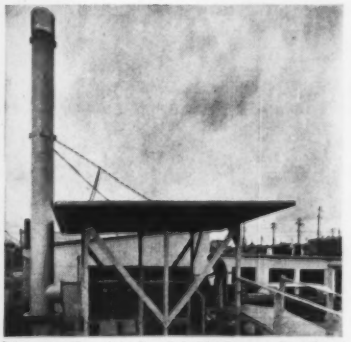
For boilers or incinerators — Van-Packer stacks can be installed inside or outside to handle boilers, furnaces or incinerators. Comes in seven diameters from 10-inch ID to 30-inch ID. Handles all fuels.

Available nationwide—Van-Packer Stack is available through local Van-Packer Jobbers and Special Representatives. See "Chimneys — Prefabricated" in Yellow Pages, or write Van-Packer for Bulletin IS-32 -57.



Van-Packer Stack with Standard Sections handles boilers and furnaces efficiently. Can be superimposed or floor supported.

Installing this stack is quick and easy. Three-foot sections are simply cemented atop one another with acidproof cement.



Van-Packer Stack with Hi-Temp Sections handles industrial incinerators with continuous flue gas temperatures of 2000° F.

Van-Packer PREFABRICATED REFRACTORY **Stack**

Van-Packer Company • Division of The Flintkote Company
1232 McKinley Ave., Chicago Heights, Ill. • Phone: Skyline 4-4772

Sweet's

new... Powermaster®

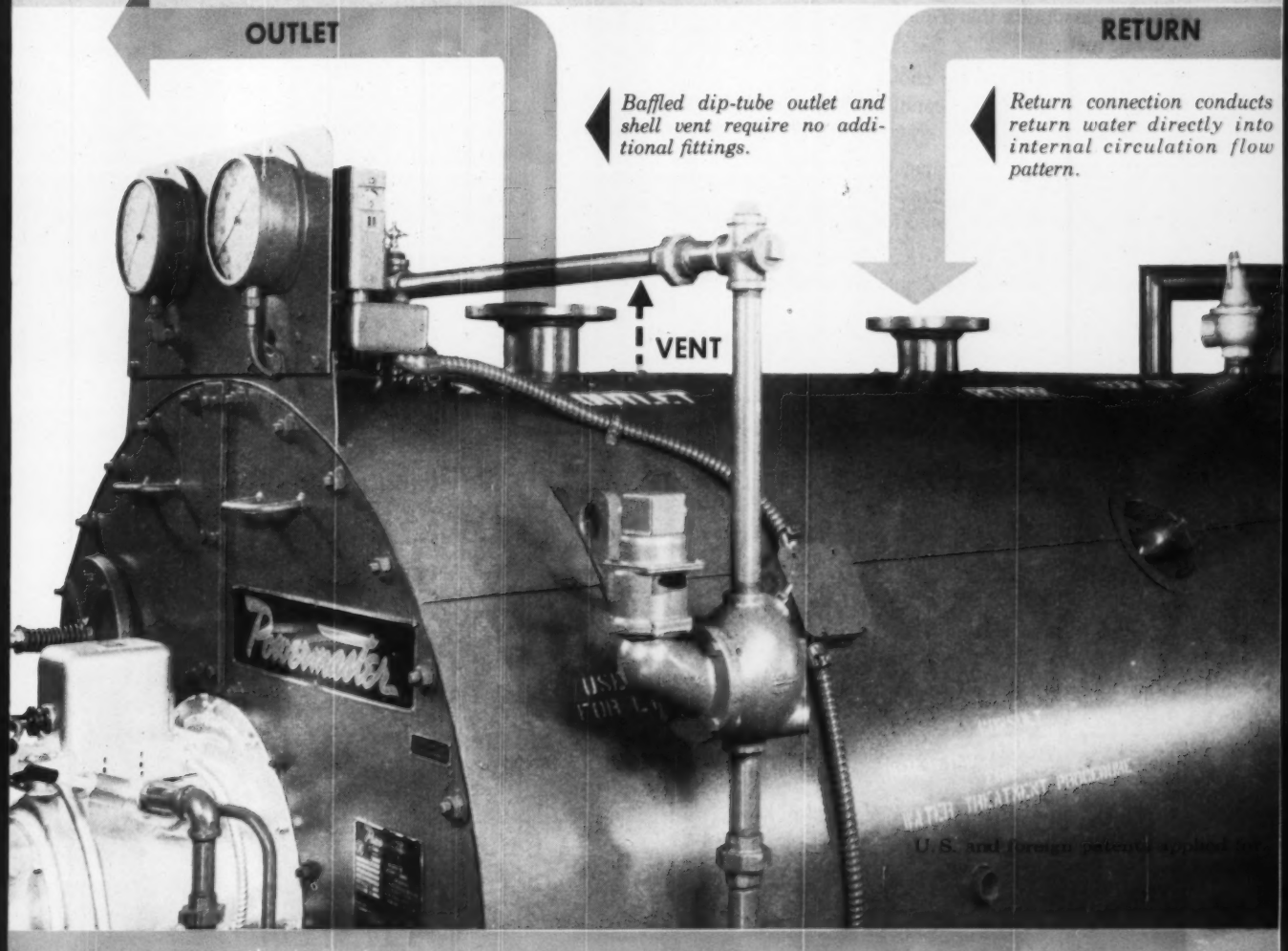
PACKAGED AUTOMATIC BOILER

for forced circulation hot-water heating

The newest O&S *Powermaster* boiler design is engineered specifically for modern forced circulation heating applications. It is the *first* hot water heating boiler developed for such institutional, commercial and industrial applications.

Two years of concentrated research and development in internal boiler water circulation produced this modern automatic unit. It now affords building owners, heating contractors, consulting engineers and architects an efficient and reliable boiler ideally suited to the wide variety of flow rates and temperatures met in present-day hot water heating system designs for schools, apartments, shopping centers and industrial plants.

Only with this new *Powermaster* do you have complete assurance that the burner, controls and boiler itself meet the highest standards of hot water heating system performance. This advanced design can save you fuel dollars, efficiency dollars and maintenance dollars. Call in your O&S representative to find out why . . . write for descriptive bulletin.


OUTLET
RETURN
Baffled dip-tube outlet and shell vent require no additional fittings.
Return connection conducts return water directly into internal circulation flow pattern.
VENT
Powermaster

Builders of Dependable Boilers Since 1885

Orr & Sembower, Inc., Reading, Pa.

O&S

ORR & SEMBOWER, INC.

POWERMASTER/Models 3, 4 and 5...POWER-PAK and BURNERS

New Beauty on Cleveland's Skyline

Got lifetime service valves and got them fast by choosing JENKINS

More than top quality in valves was required for this $17,000,000 aluminum-and-glass building, completed in April 1958 to provide offices for the Cleveland Electric Illuminating Company and other industrial and commercial tenants. In addition to valves that would last for the building's lifetime, the builders sought assurance that a close delivery date would be met.

Both were assured by the choice of Jenkins Valves for all plumbing, heating and air conditioning lines.

For almost a century the name JENKINS has meant enduring quality. Jenkins Valves in service for fifty years and good for many more are often reported.

And, when valves are needed quickly, Jenkins' efficient, national system of distribution can't be surpassed. Jenkins Bros., 100 Park Avenue, New York 17.

Architects:
Carson and Lundin, New York

Consulting Engineers:
Jaros, Baum & Bolles, New York;
McGeorge, Hargett and Associates, Cleveland

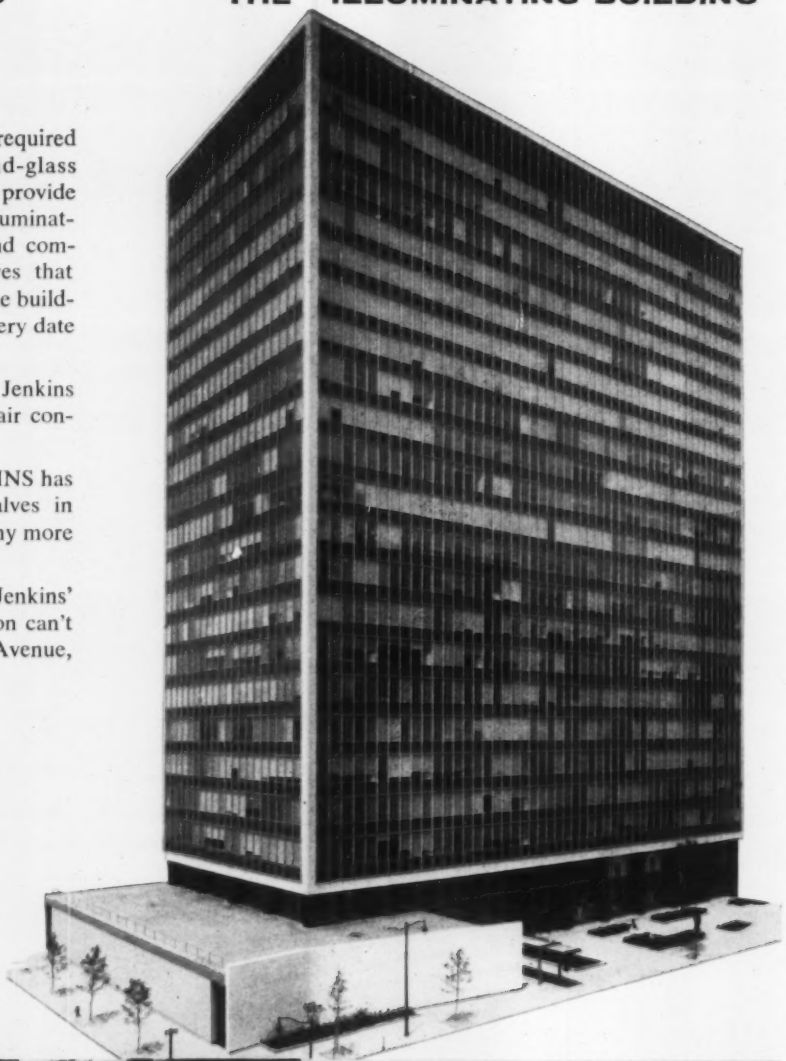
General Contractor:
George A. Fuller Company, New York

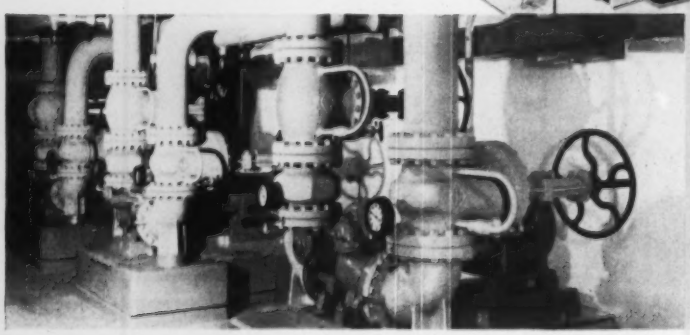
Heating-Air Conditioning Contractors:
Kerby Saunders Company, New York;
Feldman Brothers Company, Cleveland

Plumbing Contractors:
Kerby Saunders Company, New York;
Gorman Lavelle Plumbing-Heating Co., Cleveland

Managing Agents:
Ostendorf-Morris Company, Cleveland

THE ILLUMINATING BUILDING





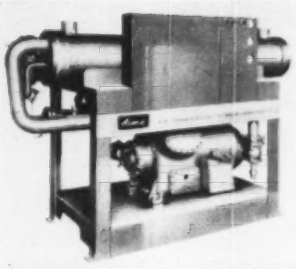
Typical of more than 4,000 Jenkins Valves of bronze, iron and cast steel serving this building owned by the 55 Public Square Corp., Cleveland.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864
Jenkins Bros

Sold Through Leading Distributors Everywhere

EQUIPMENT DEVELOPMENTS . . .

For reviews of Recent Trade Literature see page 242



Packaged Water Chiller . .

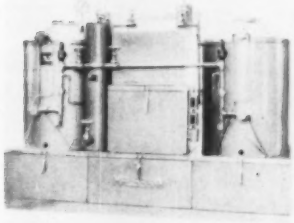
. . .designed to provide chilled water required for air conditioning systems in medium, large commercial, industrial process applications—*Acme Industries, Inc., Dept. HPAC, 600 N. Mechanic St., Jackson, Mich.*

Unit consists of hermetic compressor, shell and tube water cooler, water cooled condenser, heat exchanger, safety and operating controls, interconnected refrigerant piping, structural steel frame. All factory assembled, wired, serviced with holding charge of refrigerant. Unit also available without water cooled condenser for use with evaporative condenser. "Model HE" capacities range 20 to 60 tons; "Model DE" capacities, 20 to 125 tons. "RG-3" through "RG-10" chillers contain one complete refrigerant circuit with single sealed type motor-compressor, one cooler and one condenser; "RG-15" through "RG-30" models contain two complete separate refrigerant circuits with two each of all components cited above.

Cooling Towers . . .

. . .with capacity adjustable over wide range through varying spray pressure—*Baltimore Aircoil Co., Inc., Dept. HPAC, P. O. Box 7322, Baltimore 27.*

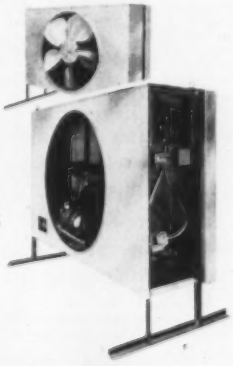
Increase in pump size said to be only requirement for increasing capacity of "Flexi-Tower." Unit includes pressure gage for accurate calibration of spray pressure and resultant capacities. Factory assembled, blow-through, propeller-fan cooling tower has counter flow design in galvanized steel construction and is available in capacities 10 to 215 tons.



Steam Generator . . .

. . .composed of two 15 bhp heater coils and two burners with individual controls—*Malsbury Mfg. Co., Dept. HPAC, 845 92nd Ave., Oakland 3, Calif.*

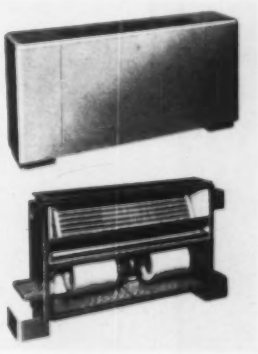
Steam generator has flash-type continuous coil construction. Produces dry, saturated steam 2 to 3 min from cold start, says manufacturer. Burner operates only when steam required. Floor space of 30 × 96 in. needed to install package steam generator. Total weight of unit is 2500 lb.



Remote Condenser . . .

. . .available in five models with ratings 10 to 30 tons—*Dunham-Bush, Inc., Dept. HPAC, 179 South St., West Hartford 10, Conn.*

"LRCU" large remote condensing unit consists of "BC-P" air cooled condenser with compressor, receiver, electrical controls, other refrigeration accessories mounted within casing of unit. Compressors single or dual; with dual compressors, separate circuits furnished. Each circuit complete with set of components and supplied with compressor, motor, magnetic starter.



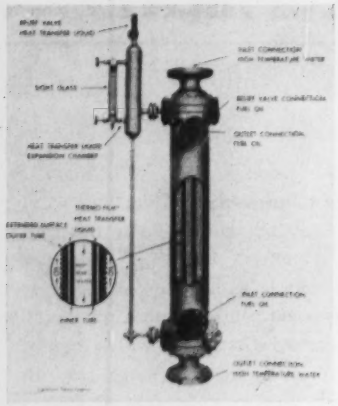
Fan Coil Units . . .

. . .designed for summer cooling, winter heating of multi-room structures—*American Standard, American Blower Div., Dept. HPAC, Detroit 32.*

"Diaflo" fan coil units available in two basic units: vertical or horizontal. Vertical design may be used with standard top-discharge enclosure, free-standing front-discharge enclosure or custom enclosure with top or front discharge. Horizontal design used with standard or custom enclosure with top or front discharge. Horizontal design used with standard or custom enclosures. Available in 200, 300, 400, 600 cfm sizes. Coils removable, reversible. Fan, motor assembly also removable. Filters are 1 in. thick, disposable or cleanable types.

EQUIPMENT DEVELOPMENTS

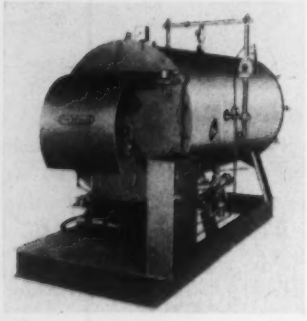
Continued



Fuel Oil Heater . . .

. . . engineered for direct use in oil-fired high temperature hot water systems—*Davis Engineering Corp., Dept. HPAC, 30 Rockefeller Plaza, New York.*

"Thermo-Film" fuel oil heater has number of double tube elements enclosed within heater shell. Oil flows through shell; boiler water flows in opposite direction through inner tube. Thin film of heat transfer fluid separates oil, water; free oil cannot contaminate hot water stream.



Packaged Boilers . . .

. . . designed exclusively for hot-water systems—*York-Shipley, Inc., Dept. HPAC, 500 Jessop St., York, Pa.*

Boilers intended to deliver continuous heat at varying rates of heat flow or intermittent heat at fixed rate of heat flow. Line includes 14 models in capacities 30 to 500 hp. Standard pressure is 30 psi; standard maximum temperature 250 F. Burners specified for light oil, heavy oil, gas or gas-oil combinations.

Pulsation Dampener . . .

. . . developed to fill requirements for any size or type of reciprocating pump—*Ball Mfg. Co., Inc., Dept. HPAC, P. O. Box 2275, Torrance, Calif.*

"Type BL" pulsation dampener installed directly on discharge line of pump for maximum dampening efficiency, convenience of operation, says manufacturer. Where extreme variations in operating pressure occur, two dampeners—one with low pre-charge, the other with high pre-charge—can be installed. Bladder of synthetic rubber; body of cast alloy steel.

Air Conditioner . . .

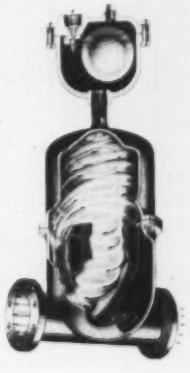
. . . available in capacities 5 through 15 tons—*Embassy Steel Products, Dept. HPAC, 890 Stanley Ave., Brooklyn.*

Water cooled air conditioner designed for commercial, industrial applications. All controls reached through front access door. Expansion valve set for superheat adjustment. Compressors spring mounted with thermal overload for motor protection. Features cited: refrigerant distributor said to provide added cooling capacity; suction and discharge lines equipped with vibration eliminators for quiet operation.

Polyphase Motors . . .

. . . in totally enclosed design with ratings through 500 hp—*Wagner Electric Corp., Dept. HPAC, 6400 Plymouth Ave., St. Louis 14.*

Cooling of motor provided by series of tubes through which outside air is forced by external blower; internal blower at each end of rotor circulates warm air inside motor through ducts in rotor and stator and around cooling tubes. Standard enclosed motors built with Class A insulation for 55 C rise or with Class B insulation for 75 C rise. Explosion-proof motors built with Class A insulation only.

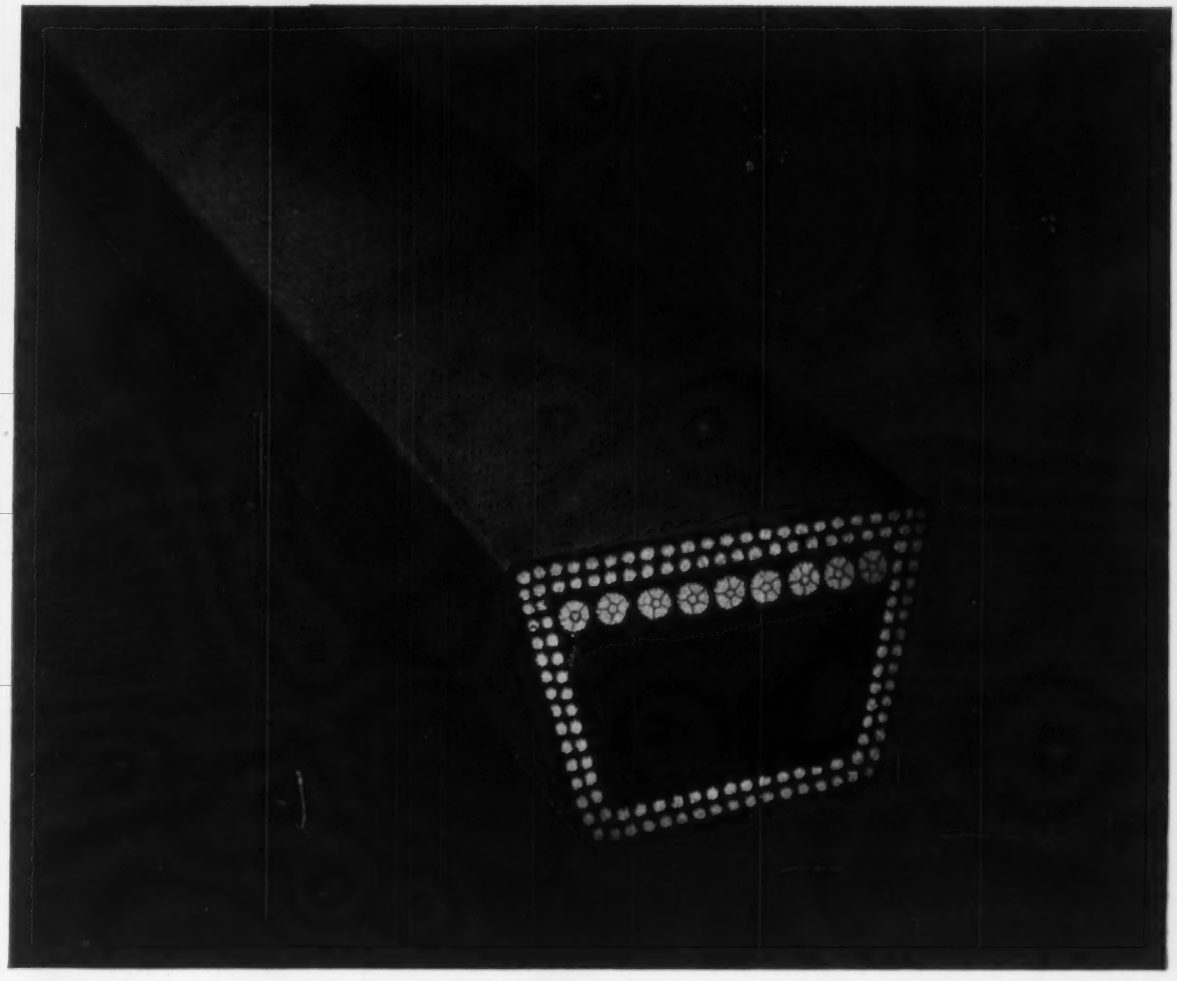


Separator . . .

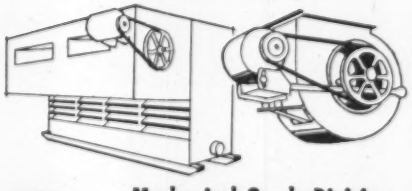
. . . designed for steam, air, gas applications, utilizing centrifugal force to separate moisture, oil entrained in vapor flow—*Wright-Austin Co., Dept. HPAC, 3245 Wright St., Detroit 7.*

Steam or gas directed through annular passage increasing speed to produce maximum centrifugal force. Entrained matter clinging to outer wall drains to bottom of separator to automatic trap. "Type T" available with screwed connections through 3 in. and 125 # ASA flanges through 8 in. pipe sizes.

US RUBBER V-BELTS



Quiet . . . smooth . . . vibration at the vanishing point



Unerring electronic controls; new methods of curing; the facilities of the largest and most modern plant devoted exclusively to the manufacture of endless transmission belts—these are the factors that bring to the heating and air-conditioning industry the one V-belt that erases vibration to the vanishing point.

The U. S. V-belt contributes greatly to the silent and efficient operation of fans, pumps, compressors, blowers—large or small—wherever power transmission is required for air-conditioning and refrigeration units.

• • •

When you think of rubber, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

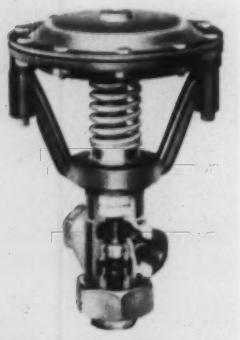
Mechanical Goods Division

US RUBBER **United States Rubber**

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

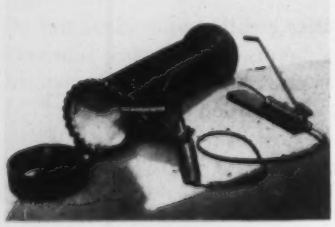
EQUIPMENT DEVELOPMENTS
Continued



Diaphragm Valve . . .

. . . designed for leak-free operation and fast response in hot or cold raw water, steam, air or gas service—*Sinclair-Collins Valve Co., Dept. HPAC, 454 Morgan Ave., Akron 11, Ohio.*

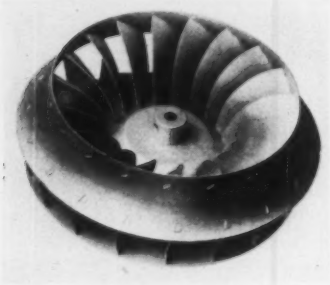
Diaphragm-operated, ½ in. NPT, 350 psi control valve available in three-way or reverse acting types. Features cited: one-piece hardened stainless steel said to prevent loosening in service; leak-free replaceable hardened seat rings intended to resist wire drawing under severest operating conditions; complete interchangeability of parts; valve seat inspected by removing union nut retaining lower seat. Valves in bronze or ductile iron bodies with stainless steel trim. Available in optional sizes of ½ in. NPT inlet, cylinder or drain ports; or ½ in. NPT inlet with ¾ in. NPT cylinder and drain ports. Top diaphragm, actuated by 20 to 35 psi air, can be operated manually or by pneumatic or electro-pneumatic cycle control device.



Hydraulic Pipe Cutter . . .

. . . said to require no vice or turning—*Wheeler Mfg. Corp., Dept. HPAC, Ross Road, Ashtabula, Ohio.*

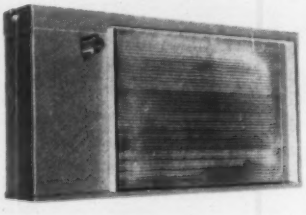
According to manufacturer, cutter will cut cast iron water main or cement-lined cast iron water main from 4 to 12 in., standard or extra-heavy soil pipe 6 through 15 in., terra cotta or clay tile 6 through 36 in., cement-asbestos pressure pipe 6 through 10 in. Cutter's chain wrapped around pipe, pulled through jaws to nearest ring. Adjusting screw tightened to take up slack, hydraulic pressure applied by hand or electric pump.



Air Impeller . . .

. . . designed to operate in range of performance between axial fans and centrifugal blowers—*Air Impeller Div., Torrington Mfg. Co., Dept. HPAC, Torrington, Conn.*

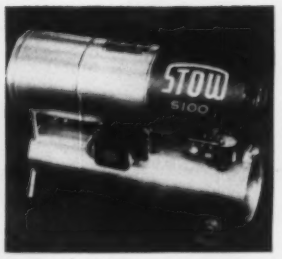
"H" mixed-flow impeller composed of 19 contoured blades mounted between curved inlet ring and back plate. Blades have complex, compound blade curvature. Produces four sizes for air flow range 150 to 800 cfm. Overall dimensions: 9 × 3 in.; 10 × 3-11/32 in.; 11¼ × 3¾ in.; 12⅝ × 4-7/32 in.



Cooling Coils . . .

. . . intended for small commercial air conditioning installations—*Halstead & Mitchell, Dept. HPAC, Bessemer Bldg., Pittsburgh 22.*

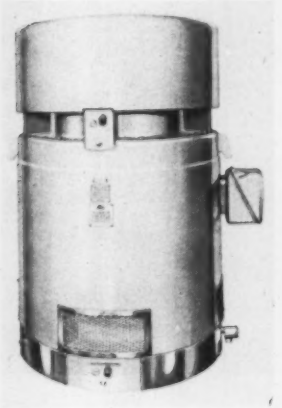
"Type HR" enclosed direct expansion cooling coils available in 7½ ton capacities. May be used with refrigerants 12 or 22. Can be placed in horizontal position on supply ductwork.



Portable Heater . . .

. . . designed to provide temporary heat in maintenance shops, boiler rooms, welding shops, other unheated areas—*Stow Mfg. Co., Dept. HPAC, 350 Shear St., Binghamton, N. Y.*

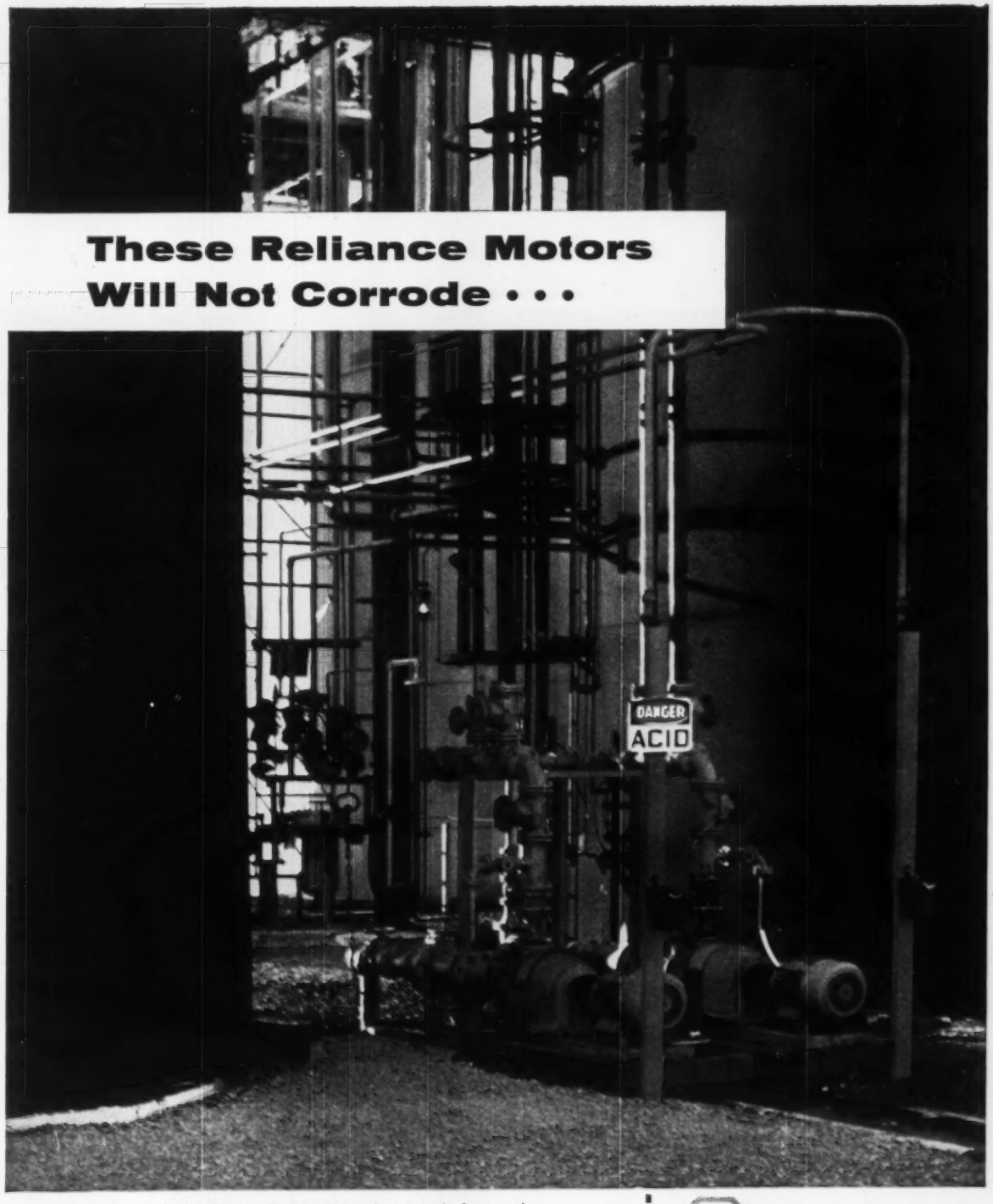
Portable oil-fired heater has built-in thermostat, twin disc air control to compensate for variations in fuel, temperature, altitude. Low-fuel cutoff switch provided. Available in six sizes from 100,000 to 1 million Btu per hr.



All-Weather Motor . . .

. . . intended for outdoor operation under weather conditions including hurricane winds, driving rain, snow, sleet, wind-blown sand—*Louis Allis Co., Dept. HPAC, 427 E. Stewart St., Milwaukee 1.*

Motor developed to meet NEMA Type II weather protected specifications. Manufactured in ratings 250 to 2000 hp, in hollow shaft and solid shaft construction. Intended for such applications as chemical, petroleum processing, irrigation, municipal and industrial uses. Ventilating air goes through three 90 deg changes in direction, is lifted vertically through screens, expands in air passage so velocity is reduced to less than 600 fpm.



These Reliance Motors Will Not Corrode • • •

Write for bulletin B-2406 for further information on 1 to 125 hp corrosion-proof motors.

RELIANCE ELECTRIC AND ENGINEERING CO.

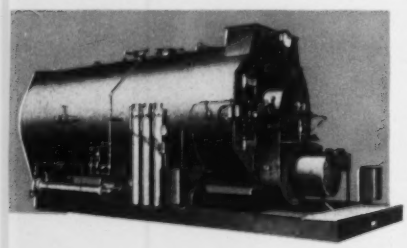
DEPT. 3611A CLEVELAND 17, OHIO
CANADIAN DIVISION: TORONTO, ONTARIO
Sales Offices and Distributors in Principal Cities

MASTER REEVES

The Flexible Steam Generator that Allows for Tomorrow's Growth

The installation of one Cyclotherm often leads to the installation of several more, because they're designed for the needs of tomorrow as well as for the needs of today.

Only Cyclotherm gives you added steam capacity in units ranging from 15 HP to 750 HP, with 18 sizes to choose from. Cyclotherms fit boiler-room space—they're up to ⅓ smaller than other Package Boilers. They need no foundation, no excavation, no costly stack. Cyclotherm Steam and Hot Water Generators come to you complete—ready to work—with one manufacturing responsibility back of the entire equipment. Cyclotherm's Cyclonic Combustion guarantees a minimum of 80% efficiency. Maintenance costs are cut by up to 50%.



And only Cyclotherm manufactures a specially designed line of Package Hot Water Generators, in capacities ranging from 670,000 BTU per hr. to 6,700,000 BTU per hr. Send the coupon below and a Cyclotherm Sales Engineer will promptly call.

Seven Cyclotherms Installed Without Interrupting Steam Supply!

Here's how H. D. Koblitz, Cleveland property management company, changed steam generators without interrupting steam supplied to 365,000 sq. ft. of plant area. On a balcony over the fire aisle, they installed 4 Cyclotherms while the old installation still operated. Then they dismantled the old boilers, putting 3 Cyclotherms in their place. A complete new installation, without one second's loss of steam!

YEARS AHEAD IN STEAM & HOT WATER GENERATION

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STEAM AND HOT WATER GENERATORS

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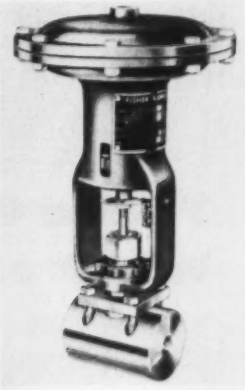
Please send me free 4-page folder on Cyclotherm Steam and Hot Water Generators.

EQUIPMENT DEVELOPMENTS

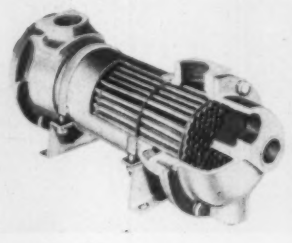
Continued



Valves . . .

. . . designed for applications involving corrosive liquids—*Fisher Governor Co., Dept. HPAC, 205 S. First Ave., Marshalltown, Iowa.*

Bodies of valves formed from bar stock, available in material such as 316 stainless steel, monel, etc. Sizes ½ to 1 in. in globe and angle styles, single port construction. Globe bodies have renewable screwed-in seat rings; angle bodies may have either screwed-in rings or rings machined directly in body. Plastic stuffing box packing standard. Bodies will handle 1500 psi at 450 F. Bodies intended to fit company's direct and reverse acting topworks.

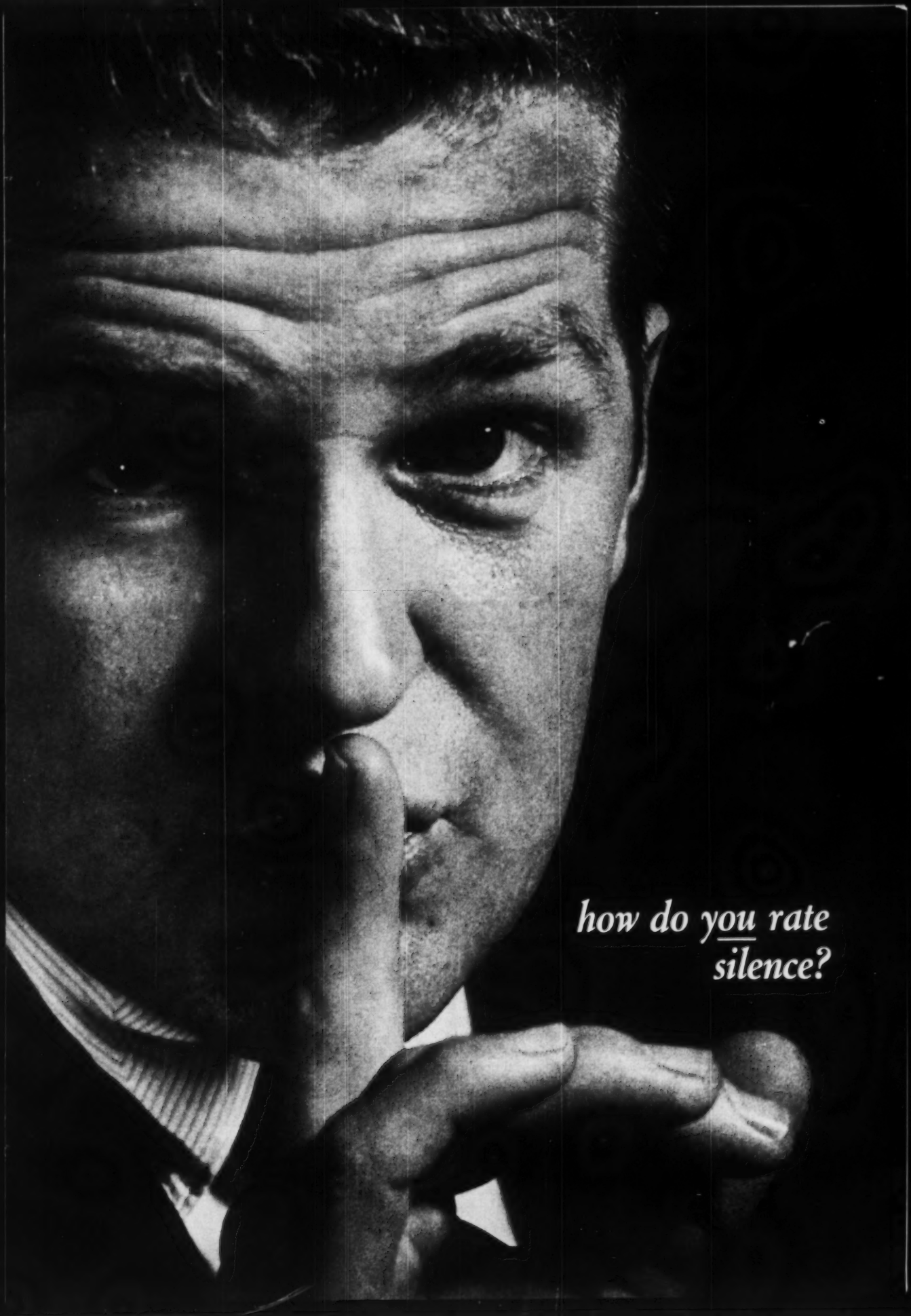


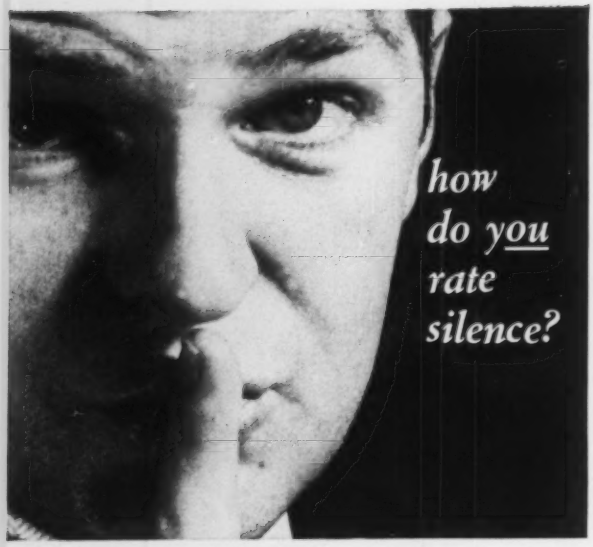
Heat Exchangers . . .

. . . in shell-and-tube design in sizes 1.3 to 200 sq ft of surface—*Perfex Corp., Dept. HPAC, 500 W. Oklahoma Ave., Milwaukee.*

"Perfexchanger" heat exchanger design prevents bypass around tube bundle, increasing efficiency, says manufacturer. Unit has universal mounting bracket, detachable, rotatable to 360 deg. Available in single, two and four pass models in range of sizes to meet variety of applications.

(*Continued on page* 194)


how do you rate
silence?

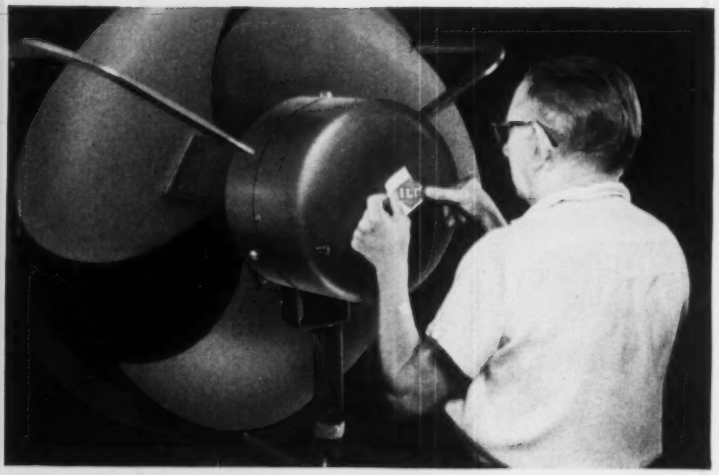


When it's ventilating equipment . . .

What factors are most important to men who specify ventilating equipment? What features do they look for first to make sure equipment is high quality?

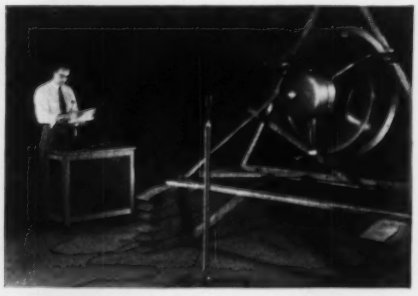
A recent nationwide survey made by an independent research organization for Ilg throws considerable light on the subject . . . proves conclusively that "quietness of oper-

Here's how ILG *propeller fans assure quiet operation,*



What's in a Name? Plenty—when the name is Ilg. This "One-Name-Plate" guarantee covers *both* the quiet-running, self-cooled motor *and* the dynamically balanced, patented design fan wheel. Whether you specify or install Ilg Direct Drive Propeller Fans, you can count on quiet, vibration-free operation, low operating costs. For Ilg Type "Q" Fans and Ilg enclosed motors are designed, built, assembled and tested under one roof to exhaust *more* air *more* quietly for *more* years.

"Inhale . . . Exhale." Follow the flame and see why Ilg self-cooled, enclosed, permanently lubricated motors stay cleaner, run quieter, last longer. Fresh air (flame, here) enters vent pipe, circulates through motor, exhausts at front of fan. Ilg permanent-split capacitor single-phase and 3-phase motors never run "hot," have no wearing parts.



"Silence Is Golden." Ilg Propeller Fans feature direct drive to eliminate the noise, slippage and friction losses of belts and pulleys. In addition to "quietness tests," all Ilg Fans undergo exhaustive balancing tests to motor rotors and fan wheels before and after assembly to assure smooth, quiet operation.

For fans built to satisfy your "specs"...

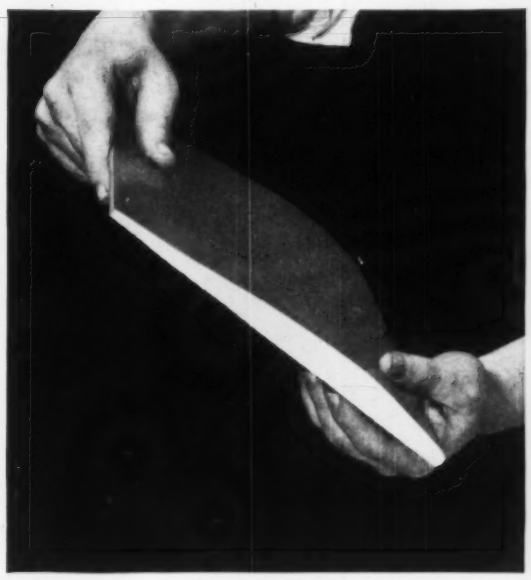
consulting engineers rate quiet operation No. 1 in preference poll

ation" rates *first* with consulting engineers who specify fans and ventilating equipment.

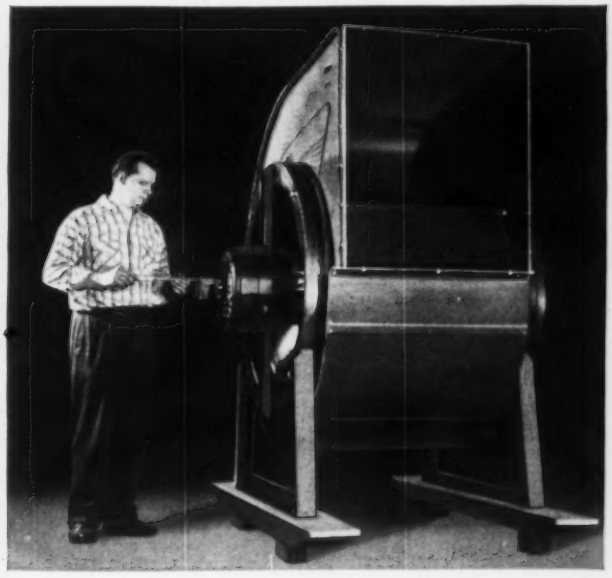
You can look to Ilg Fans and Ventilators for quietness coupled with high air volume. Consulting engineers choose Ilg because Ilg equipment combines so many of the points of quality they insist on: vibration-free operation, for example; long life; low maintenance expense; ease of repair; low operating costs—just to name a few.

Some of the reasons Ilg equipment rates so high with those who specify are shown below. For complete details on Ilg Propeller Fans, write for Catalog No. 153; on Ilg Airfoil Centrifugal Fans, send for Bulletin No. 257.

and ILG centrifugal fans vibration-free performance, low maintenance



Backward Is Forward. Ilg Backward Curved (BC) Blades and Airfoil design—the greatest step *forward* in blade design in 40 years—eliminate eddy currents and turbulence to assure quieter operation, undergo *less* drag and shock loss than blades of uniform thickness. Sound tests prove these fans can run at greater speed than older types —with *no increase in sound level.* For operations up to 9" static pressure.



Single, Silent Centrifugal. Direct-connected Ilg-built motors and Airfoil fan wheels rotate as a *single unit*—on heavy-duty, permanently lubricated ball bearings. No belts or pulleys to slip, re-align or replace periodically. No need for space-wasting separate motor mountings. Just connect an Ilg BC Airfoil Centrifugal and you're ready for any ventilating and air-conditioning job.

specify ILG

ILG ELECTRIC VENTILATING COMPANY
2826 N. Pulaski Road, Chicago 41, Illinois
Offices in 57 Principal Cities
Member of Air Moving and Conditioning Association Inc. (AMCA)

Life in these excited states...

"We've been having trouble with corrosion in this section."

Corrosion is embarrassing

It's *expensive*, too. Not only in terms of equipment chewed up, but also in un-timely time losses and wasted ingredients. You save embarrassment and expense *both* with Ace chemical resistant piping, valves, pumps, tanks, and special lined equipment. 108 years' experience at your service.

All-purpose rigid PVC. Sched. 40, 80 & 120, ½ to 4". Threaded or socket-weld fittings. Valves ½ to 2". NSF-approved. *Bul. CE-56.*

RIVICLOR *for ageless strength*

Improved design . . . now 12 gpm. All wetted parts acid-resistant, wear-resistant Ace hard rubber. Finest available. *Bul. CE-55.*

NEW *ACE Gear Pump*

Flexible poly pipe, ideal for water lines, drains, underground pipe or conduit. Sizes ½ to 2", long coils, NSF-approved for drinking water. *Bul. CE-57.*

SUPPLEX *tops in economy*

World's best chemical valves . . . at moderate prices. All-plastic, rubber-lined, or all-hard-rubber. ⅛" pet cocks to 24" gate valves.

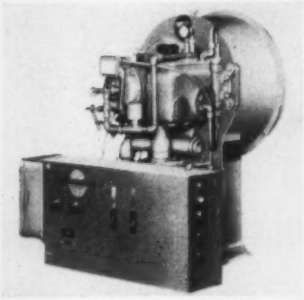
VALVE HEADQUARTERS

ACE processing equipment of rubber and plastics

AMERICAN HARD RUBBER COMPANY
DIVISION OF AMERACE CORPORATION
Ace Road • Butler, New Jersey

EQUIPMENT DEVELOPMENTS

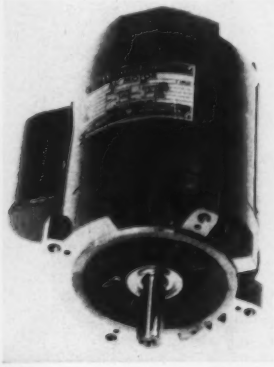
Continued from page 190



Forced Draft Burners . . .

. . . developed for application to multiple pass Scotch marine, water tube, firebox boilers, other types of heat receivers for pressurized operation—*Ray Burner Co., Dept. HPAC,* 1301 *San Jose Ave., San Francisco* 12.

Small capacity rotary type package forced draft burners are factory assembled, wired, ready for installation. Fully automatic units develop capacities 40 to 90 hp with electronic control, light or heavy oil operation, combination gas and oil operation.



Jet Pump Motors . . .

. . . designed especially for operation of water system centrifugal or ejector type pumps—*Westinghouse Electric Corp., Dept. HPAC, Box* 2099, *Pittsburgh* 30.

"Jet-Line" motors have 48 and 56 frames for direct pump mounting. Equipped with grease-lubricated ball bearings for vertical or horizontal mounting. Available in split-phase, capacitor-start and polyphase models, rated at 1/3 or ½ hp in the 48 frame model. In single or dual voltage, 2850 or 3450 rpm. Dual voltage motors have spade connectors for ease in changing voltage.

EQUIPMENT DEVELOPMENTS
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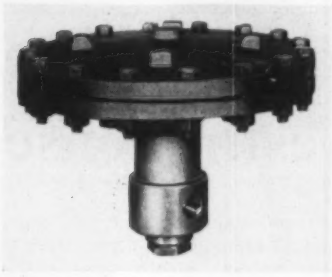
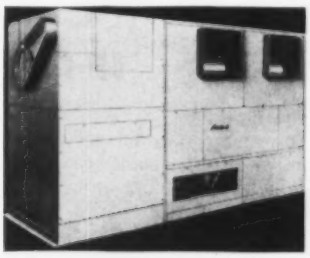


Reducing Valve . . .

. . . developed for handling large ratio pressure reductions from 6000 psi initial pressure to outlet pressures from 100 psi to within 20 per cent of the initial pressure in one stage—*Atlas Valve Co., Dept. HPAC, 280 South St., Newark 5, N. J.*

"Type E, Fig. 198" reducing valve adapted for air, gas or hydraulic operation. Unit employs small air reducing and relief valve for charging diaphragm chamber as means of controlling reduced pressure; can be adjusted from remote point. Trim is stainless steel with spindle and seat ring of "stellite." Wearing surfaces hard chromium plated and polished. For use with hydrogen or other gases, nylon seats available.



Packaged Air Conditioner

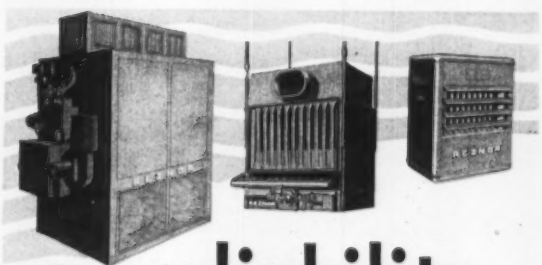
. . . designed to provide cooled, dehumidified, filtered air for commercial air conditioning applications—*Acme Industries, Inc., Dept. HPAC, 600 N. Mechanic St., Jackson, Mich.*

"Model PAC" is factory assembled, packaged air conditioner consisting of hermetic compressor, direct expansion cooling coil, water cooled condenser, centrifugal blower, refrigerant circuit, safety and operating controls in sheet steel cabinet. Internal wiring, piping completed at factory. Air discharge horizontal or vertical through duct system with fan section on either end. Compressor has provision for capacity control. Capacities from 20 to 60 tons. Similar models available with 3 through 15 tons capacity.

Pipe Bender . . .

. . . engineered to bend ½ through 1½ in. pipe and 2 in. tube to any degree or angle through 180 deg—*Senna Mfg. Co., Dept. HPAC, 732 N. Napa St., Spokane, Wash.*

"S-3 Model" operates on 110 volts, a-c, 60 cycles. Said to have same accuracy control, quick change radii adjustment features as company's other models.



reliability

Reznor heaters are designed and built for long life and reliable service. They've proved their ability to do the job in countless thousands of commercial and industrial installations. Quality always pays off in the long run. When you specify Reznor equipment you can be confident that you're specifying a quality heating system which will give your client years of trouble-free service with minimum maintenance.

RELIABILITY is just one of many reasons why there is no "equivalent" for Reznor . . . the world's largest-selling gas unit heater. Ask your Reznor distributor for the complete story or write for your free copy of "Modern Heating".

Look for Reznor under "Heaters-Unit" in the Yellow Pages

REZNOR
WORLD'S LARGEST-SELLING DIRECT-FIRED
UNIT HEATERS

Reznor Manufacturing Company, 51 Union Street, Mercer, Pa.

Stick With Fastak DUCT INSULATION ADHESIVE

STRONG BOND IMMEDIATELY

AN ADHESIVE FORMULATED ESPECIALLY FOR BONDING INSULATION TO METAL DUCTS THAT IS ECONOMICAL, YET IT CONTAINS ALL THE QUALITIES DESIRED FOR AN IMMEDIATE, STRONG, AND LASTING BOND.

ELIMINATES
- Clips, Screws, Caps, Wires, Staples, Tape, etc.
- Extra man to help hold insulation in place on wrap around jobs.
- Time lost in waiting for insulation to bond before brake forming.
- Filming over of adhesive and not bonding on large areas where certain types of adhesives are used.
- Stocking several types of adhesives for different jobs.
- Mixing.

QUALITIES
- WATERPROOF.
- EXTENDED COVERAGE—
  Brush application—230 sq. ft. per gal.
  Roller application—270 sq. ft. per gal.
- TEMPERATURE RANGE—
  Blanket.....—30° F to 325° F.
  Board.....—30° F. to 250° F.
- LABOR SAVING SMOOTHNESS OF APPLICATION.
- COLOR—Clear with slight orange tint.

DUCTAK

DUCTAK is designed for those who desire a slightly slower setting time than Fastak. Approximately one hour is required before ducts may be brake formed without danger of breaking bond. Other than this, all the features and qualities mentioned above apply to DUCTAK.

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How **WOLVERINE TUBE** Helps Westinghouse Say:

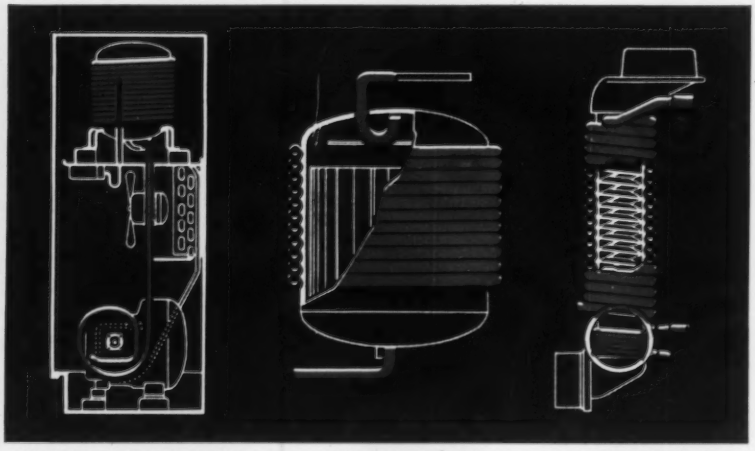
"YOU CAN BE SURE ... IF IT'S Westinghouse"

Wolverine copper tubing is an important component in the seemingly endless stream of water coolers, beverage coolers and dehumidifiers pouring from the Springfield, Mass., plant of Westinghouse Electric Corporation.

In describing its refrigeration systems, Westinghouse says—"Refrigerant flow controlled by capillary tube. No moving parts." The capillary tube Westinghouse refers to is Wolverine Capilator[®]—a tiny, plug-drawn tube manufactured to extremely close tolerances, expressly for precision control in the metering of gases and liquids.

Wolverine, is of course, widely recognized for outstanding tubemanship. Each year Westinghouse uses many miles of Wolverine commercial refrigeration tube. This rigidly quality controlled product is plug drawn to insure clean mirror-bright interior surfaces. To maintain this bright surface the tube is annealed in a reducing atmosphere. It is thoroughly inspected on both ID's and OD's to insure consistent, top quality!

Meeting the tubular needs of leading American manufacturers such as Westinghouse is Wolverine Tube's main objective—the very reason for its existence. If your company uses copper or aluminum tubing . . . or tubular-shaped parts why not specify Wolverine. You'll be in select company indeed. Wolverine's Tubemanship Book tells the complete story. Write for a copy—TODAY.



Westinghouse Hermetically-Sealed Refrigeration System

Westinghouse Storage-Type Evaporator

Westinghouse Pre-Cooler Super Sub-Cooler

These three drawings are typical of the areas where Wolverine tube is used in Westinghouse products.

CALUMET & HECLA, INC.
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Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

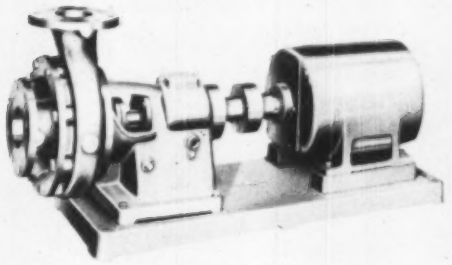
PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA.
SALES OFFICES IN PRINCIPAL CITIES.

EXPORT DEPT. 13 E. 40TH STREET, NEW YORK 16, N. Y.

See Wolverine's exhibit at the 14th International Heating and Air Conditioning Exposition, Philadelphia, Pa., January 26-29.

EQUIPMENT DEVELOPMENTS

Continued



Centrifugal Pumps . . .

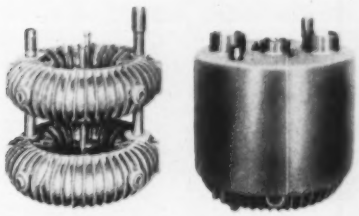
. . . with ASA number standardization to indicate dimensions, other specifications, characteristics—*Taco Heaters, Inc., Dept. HPAC, 1160 Cranston St., Cranston 9, R. I.*

Manufacturer has adopted ASA preferred number standardization used to indicate important linear dimensions, other characteristics. Other features cited: broad range of performance; interchangeability of parts; statically and dynamically balanced; rugged construction; quiet motor. Units are self-ventilating installed in normal position with discharge up. Impeller bronze. Cooling jacket for use with stuffing box in closed type and of cast iron; also available for temperatures to 320 F. Pumps tested at 250 psi.

Steam-Heated Piping . . .

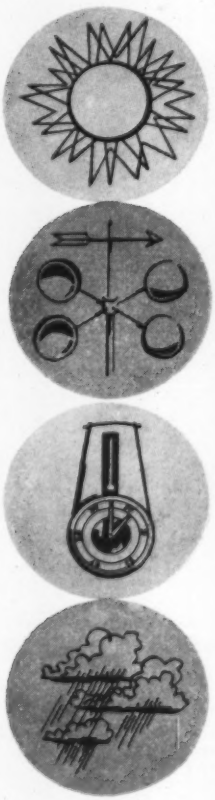
. . . with new 6 in. standard size limit—*Aluminum Co. of America, Dept. HPAC, 1501 Alcoa Bldg., Pittsburgh 19.*

Extruded aluminum pipe with integral steam passage previously available in 1 through 4 in. Now supplied in 6 in. standard and 8 in. on special order.



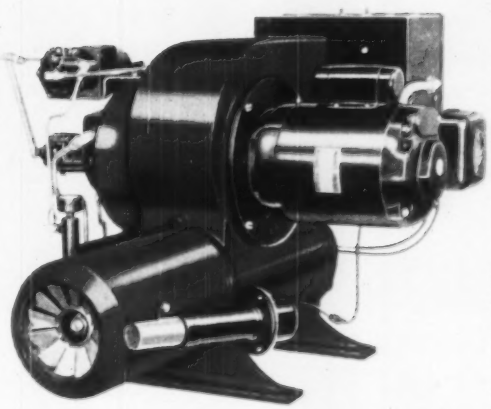
Bell Heater . . .

. . . with 12 sq ft of heating surface in cylindrical bell 15¼ in. diam × 16½ in. high—*Davis Engineering Corp., Dept. HPAC, 30 Rockefeller Plaza, New York.*



FOR HEATING AT ITS BEST
WHEN WEATHER DOES ITS WORST —

HEV-E-OIL BURNERS



Hev-E-Oil burners furnish all the air necessary for combustion, assuring perfect fire control under all weather conditions. Low fire start that builds up gradually to the flame size required means smooth, safe operation. And once the burner is set for greatest efficiency, it *stays* that way no matter what the weather.

A complete package! Fire tested! Automatic, electronic controls. Meets all codes. Easy to install . . . Hev-E-Oil models from 5 to 150 gph. Also available, Hev-E-Duty power gas burners and combination gas/oil burners from 720,000 to 21,000,000 B.T.U.

For more information write Industrial Combustion, Inc., 4507 N. Oakland Ave., Milwaukee 11, Wis., Dept. HPA-11.

INDUSTRIAL COMBUSTION INC.

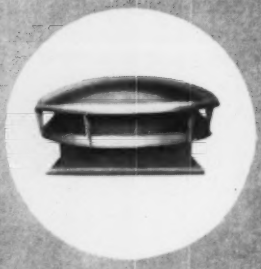
EXECUTIVE OFFICE: 4507 N. OAKLAND AVE., MILWAUKEE 11, WISCONSIN

ACCEPTED Allen ROOF VENTILATION

Whatever your ventilating needs, be sure to see how Allen equipment can meet your requirements efficiently and economically.

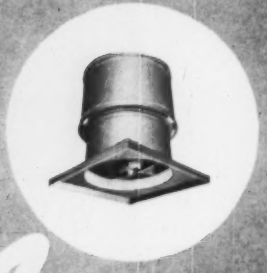
NEW "I-LINE" for EYE APPEAL

The new "I-Line" provides an attractive low contour, assuring maximum capacity or efficiency with the minimum over-all height.



POWERFUL "VD" for HIGH VELOCITY

By moving a large volume of air at high velocity, this Vertical Discharge fan keeps fumes from sifting back into building.



Allen

. . . is prepared to investigate ventilating problems and plan systems for the efficient removal of heat, fumes, vapor or dust.

WIND-DRIVEN TURBINES

Three types of Allen turbines take full advantage of the economy of natural air movement.

EXHAUST FANS

Remote drive Staxauster is designed to handle corrosive fumes, and/or high temperature air.

THE ALLEN LINE

Write today for catalog that gives specifications and performance data on these and other units in the Allen ventilator line.

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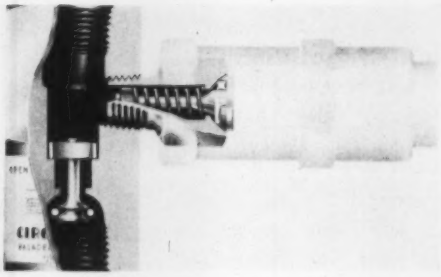
Roof Ventilators for Every Commercial and Industrial Need

REPRESENTATIVES IN PRINCIPAL CITIES

EQUIPMENT DEVELOPMENTS

Continued

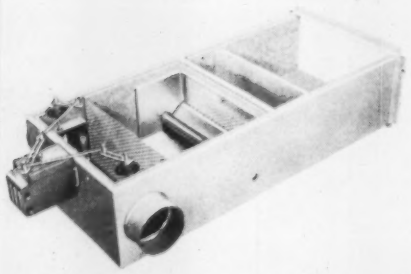
Tank suction bell heater designed to speed withdrawal of No. 6 fuel oil from tank storage. Unit consists of dome-shaped housing open at bottom to expose cast finned heating sections. Rests on bottom of No. 6 fuel oil tank attached to oil suction line heating viscous oil to flow temperature. Steam, hot water or heat transfer liquids serve as heating media.



Gage Protector . . .

. . . designed to provide quick and precise action to protect gages from over-pressure for actuation from 5 to 2400 psi—*Circle Seal Products Co., Inc., Dept. HPAC, 2181 E. Foothill Blvd., Pasadena, Calif.*

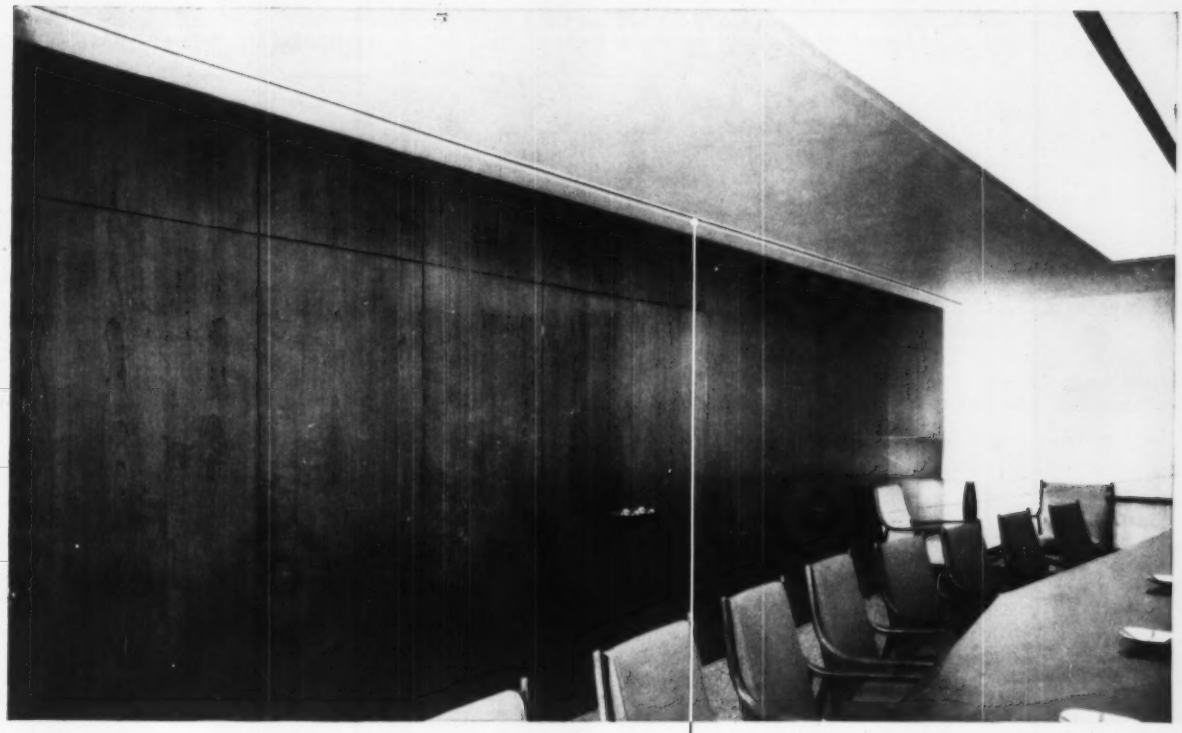
Protection system provides characteristics necessary for protection of gages, operating personnel. Gage protector valves said to overcome O-ring breakaway friction problem characteristic of piston type units. Automatic cut-out and cut-in provided. Designed for gas systems, available for liquid systems.

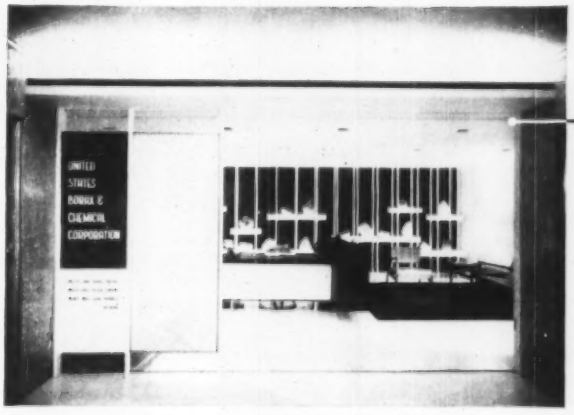


Double Duct Mixing Unit . . .

. . . with self-contained constant volume control—*Barber-Colman Co., 1300 Rock St., Rockford, Ill.*

Stabilization of double duct systems said to be simplified with unit which delivers constant cfm while mixing hot and cold high velocity air, reducing it to conventional velocities. Temperature control, volume regulation treated as separate functions. Hot and cold inlet control valves operated electrically or pneumatically with single motor mounted inside or outside unit. Air mixture held uniform within 1 F for each 10 F difference between hot, cold supply air. Catalog "No. F-8753" available describing unit.





Designer:
Maria Bergson Associates

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Look around . . . you'll see STRIPLINE by AGITAIR everywhere. And no wonder. STRIPLINE combines the best features of both slots and efficient air diffusers to provide equalized air flow throughout its entire length.

Slender, inconspicuous, practical and versatile . . . STRIPLINE slot diffusers can be located in walls, ceilings, coves, moulds, window reveals, stools . . . yes anywhere to suit interior design.

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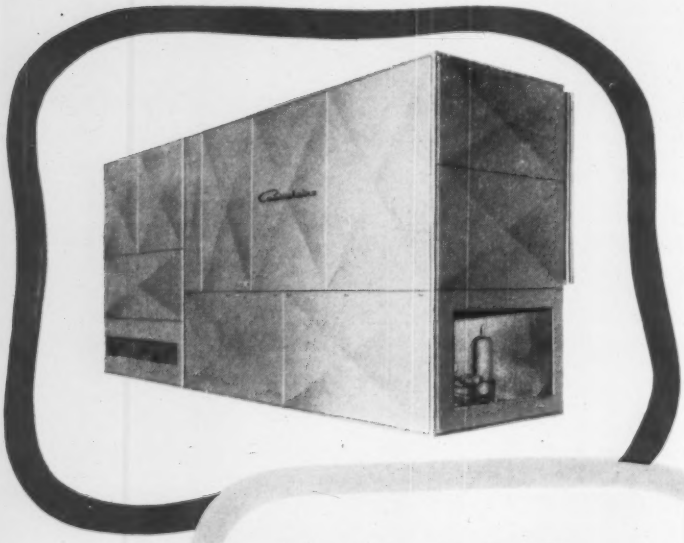
Type H Stripline shown in above installation

For Unmatched Flexibility

National-U.S.

Central Station

Packaged Air Conditioning



7½-60 h.p.

water-cooled
or
evaporative condenser

Water-cooled or evaporative condenser models in nine sizes from 7½ to 60 h.p. provide a selection from which a combination can be arranged to fit any particular situation. Each model is available in different arrangements, matched to meet any space requirements.

All units are completely engineered and packaged—require only power, ductwork and water supply connections for quick installation. And, all are factory pre-tested to minimize performance testing time.

Write today for Form AC-1001 describing the new Capitolaire Central Station *Packaged* Air Conditioning System, or contact your nearest National-U.S. representative. He'll be glad to help you.

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HEATING AND AIR CONDITIONING DIVISION
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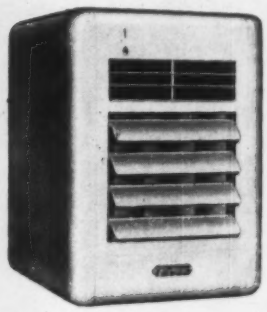
Sixty years in thermal hydronics

EQUIPMENT DEVELOPMENTS

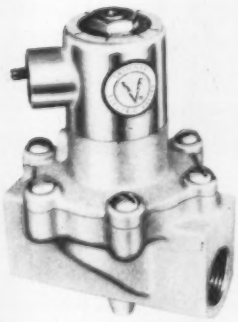
Continued



Gas Unit Heater . . .

. . . designed for installation in rooms with low ceilings—*Hastings Air Control, Inc., Dept. HPAC,* 3215 *Leavenworth St., Omaha* 5.

Units are 22½ in. high, have input ratings 25,000 to 75,000 Btu per hr; other models complete line to 250,000 Btu per hr. Intended for use with natural, LP, mixed and manufactured gases. Features cited include: quiet operation; electrically welded aluminized steel heat exchanger; stainless steel ribbon burners; fan switch; summer fan switch with pull cord; bottom access panel. Four-way distribution louvers provided as standard equipment.



Two-Way Valves . . .

. . . with $\frac{3}{4}$ and 1 in. diam orifices—*Skinner Electric Valve Div., Dept. HPAC,* 105 *Edgewood Ave., New Britain, Conn.*

"L Series" valves designed to control media such as air, oil, water, operating on pressure differential of 5 to 150 psi. Available in standard and explosionproof construction, normally closed. Valves mount directly to

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"Basic Safety Controls for Low Pressure *Steam Boilers*" was inspired by the widely praised booklet, "Basic Safety Controls for *Hot Water Boilers*," illustrated above. If you do not have a copy of the "Hot Water" booklet request it along with the "Steam" booklet. These two companion-pieces can do a real job for you.

Covers the WHY and HOW of

BASIC SAFETY CONTROLS FOR LOW PRESSURE STEAM BOILERS

If you have one of our recent booklets on Safety Controls for Hot Water Boilers, we know you will want this companion to it covering the low pressure steam boilers. It is the answer to the many requests for "a steam book just like the hot water book."

Like its well received predecessor, it deals in brass tacks solely. It tells its story in simple diagrams and equally simple explanation that wastes no words on product description. It sticks to fundamentals and concrete recommendations that answer practically all safety control problems encountered in the low pressure steam boiler field . . . your broadest field.

So well classified and indexed are the facts that whenever a job comes up—however tricky—you can turn right to the most authentic way of handling it: The right product . . . the correct hook-up . . . the proper wiring.

Use the coupon to request your copy, and if by any chance you do not have the earlier "hot water" booklet, request it too.

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Send me your new STEAM Book Bul. L-711 ☐

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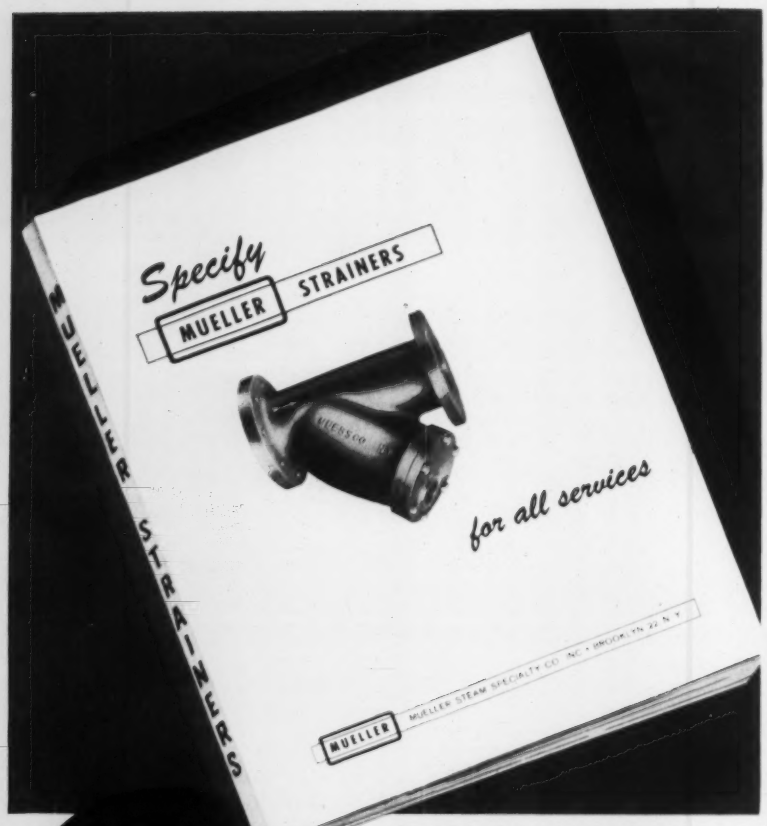


NEW 1959 CATALOGUE NOW AVAILABLE

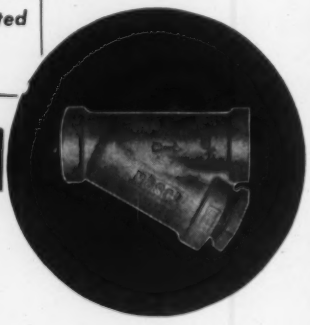
Provides full information on a complete line of Y type and Basket type strainers.

Mueller self-cleaning strainers will insure trouble free service and avoid the costly repairs or replacement of automatic equipment so often caused by the foreign matter in pipe lines.

Available in all pressures in Cast Iron, Brass, Steel or Stainless Steel in sizes ranging from ¼" through 16".

Write for your free copy of the new 1959 catalogue.

Pressure Drop Charts on Mueller Strainers— the results of actual physical tests conducted at Pratt Institute — are available on request in certified form.



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STEAM SPECIALTY COMPANY, INC.

31 Meserole Ave., Brooklyn 22, N. Y.

EQUIPMENT DEVELOPMENTS

Continued

line up in any position, can be serviced without removal. Bodies of forged naval brass; internal metal parts stainless steel.

Concrete Drill . . .

. . . with multiple carbide tipped rotary bits—*New England Carbide Tool Co., Inc., Dept. HPAC, Medford, Mass.*

Machines available in range of light, heavy duty models with bit diameters from 1½ to 6 in. Method said to permit drilling dry in hard concrete with or without rod, vertically or horizontally.

A-c, D-c Voltmeter . . .

. . . for measuring voltages up to 600 volts—*Columbia Electric Mfg. Co., Dept. HPAC, 4535 Hamilton Ave., Cleveland* 14.

"Model UV-1" made of molded plastic, weighs 9 oz, is 2 × 2 7/8 × 4 5/8 in. in size. Readings taken by inserting safety plug into receptacle on instrument, connecting voltage leads to line. One lead equipped with insulated clip, other with insulated prod. Rotary switch selects from four voltage ranges: zero to 150 a-c, zero to 150 d-c, zero to 600 a-c, zero to 600 d-c. Accuracy is 2 percent on d-c, 3 percent on a-c.

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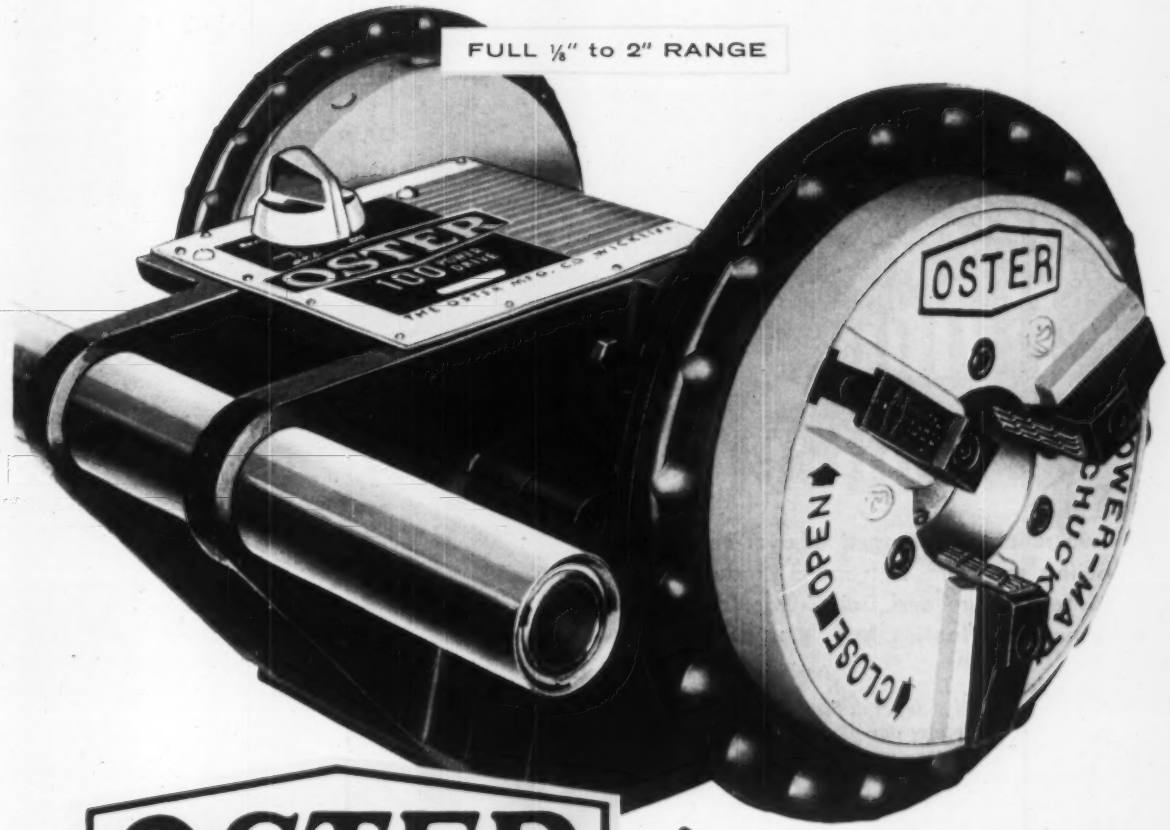

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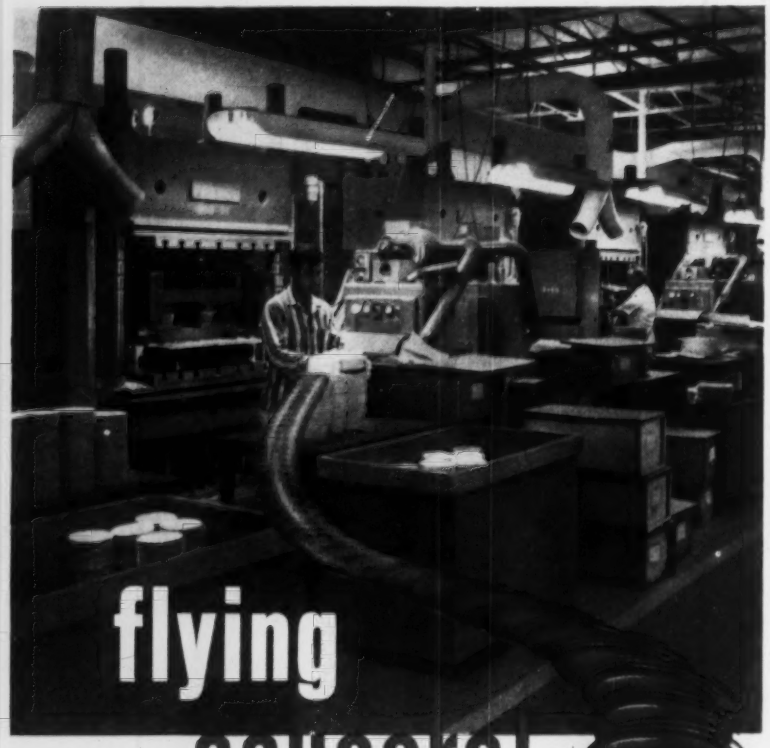


Two reliable, packaged Cleaver-Brooks boilers maintain high-speed production of Texas-ware and Dallas-ware melamine dishes for Plastics Mfg. Co., *Dallas*

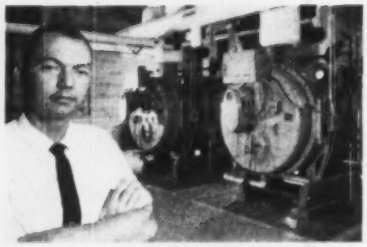
Chief engineer, W. L. Cone, Jr., states: *"Consistently dependable steam supply is keynote of our plant operation. That's why we chose two Cleaver-Brooks gas-fired boilers for our steam source.*

"One feature we appreciate about these new boilers is the easy access to their internals. Not only does this facilitate frequent inspections but also it greatly reduced their cost. There are no joints that require re-sealing every time the boiler is opened. Being hinged and davited, the doors and heads do not have to be hoisted for removal. Six bolts can be removed in less than two minutes."

Guided by experience

"Based on nine years of unfailing performance delivered by two 50-hp Cleaver-Brooks boilers we used in our former plant, there never was any question that we would install their equipment in our new plant," said Mr. Cone.

Architects for the new plant were: Thomas, Jameson and Merrill; Consulting engineers: Zumwalt and Vinther; General contractor: Carpenter Bros.; Mechanical contractor: Beard Plumbing Company, all of Dallas.



"Our 125-hp, 250-psi design pressure, gas-fired Cleaver-Brooks boilers provide all steam for compression-molding presses, office space heating and hot water heating" — W. L. Cone, chief engineer.

Cleaver-Brooks packaged boilers are America's largest selling packaged boilers. Available in 19 sizes, 15-600 hp, 15-250 psi. Oil, gas or combination oil/gas fired. For complete information contact nearest representative or write: Cleaver-Brooks Co., Dept. M, 313 E. Keefe Ave., Milwaukee 12, Wisconsin, U. S. A.

Originators and largest producer of packaged boilers

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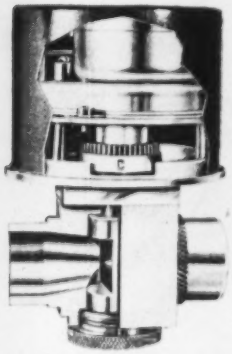
EQUIPMENT DEVELOPMENTS

Continued

Dehumidifier . . .

. . . designed to meet rigid requirements for continuous low-volume drying of air, gas or liquids—*Universal Dynamics Corp., Eng. A Div., Dept. HPAC, Box 9814, Arlington 9, Va.*

"Model A12" compact dual tower adsorption dehumidifier is capable of handling 70 cfm. Continuous drying accomplished through dual towers; 30 lb of water vapor can be removed in 24 hr. Unit is self-contained, completely automatic.



Motorized Valve . . .

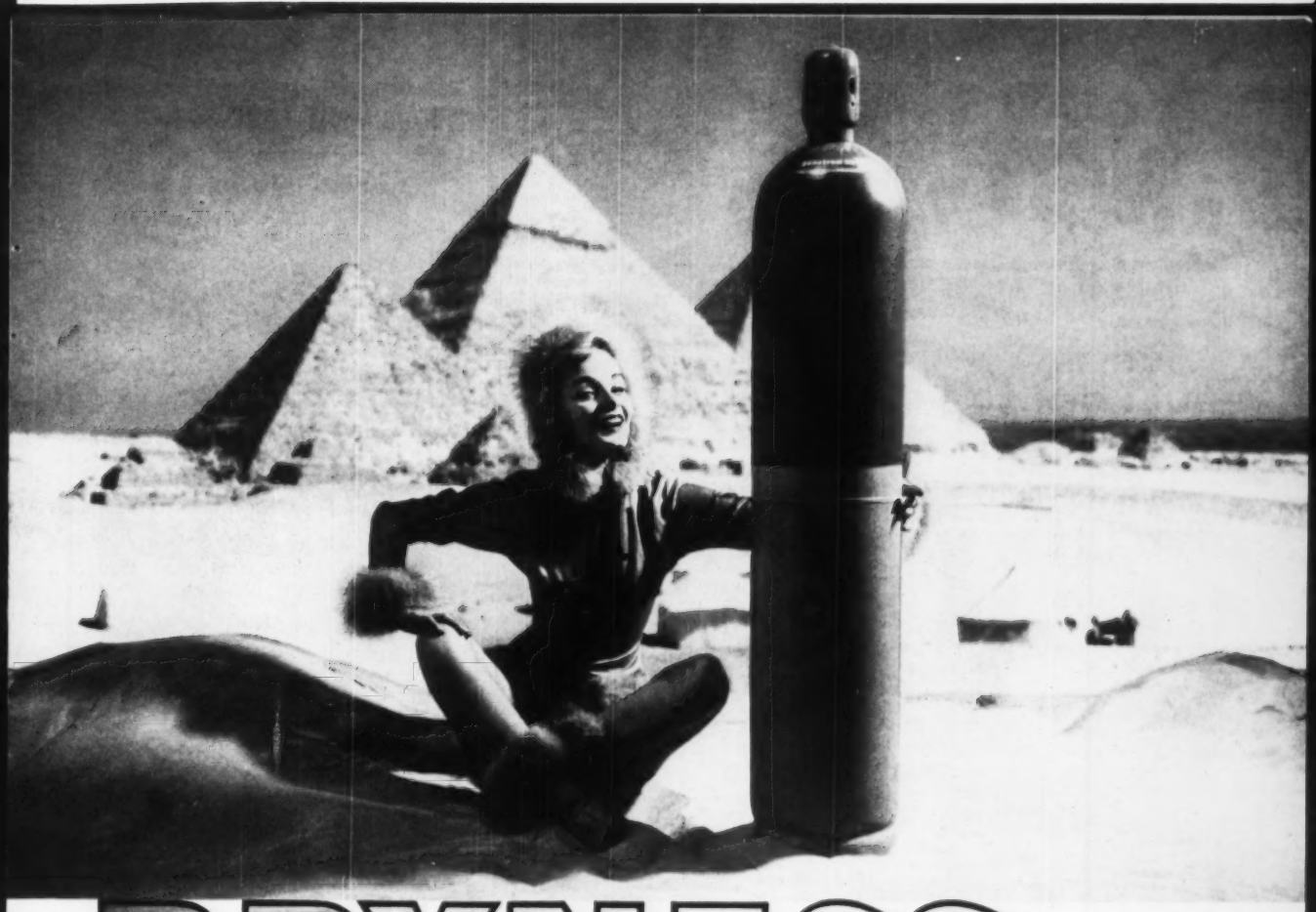
. . . designed to provide for automatic multiple zone control on any new or existing hot water heating system—*Regent Engineering Co., Dept. HPAC, Wood Dale, Ill.*

Unit operates on signal from its own thermostat. Has slow cycle of operation intended to produce modulating effect. Draws no current in open or closed position and with shutoff feature, no thermal leak occurs, says manufacturer. Available in $\frac{3}{4}$, 1 and $1\frac{1}{4}$ in. sizes.

Blueprint File Cabinet . . .

. . . for protection against dirt, dust, other foreign elements—*Momar Industries, Dept. HPAC, 4323 W. 32nd St., Chicago 23.*

"Glider" cabinets contain 10 print retainers holding 100 plans to 30 in. wide and 46 in. long. Full length top section moves in and out of channel-tracks for print withdrawals, additions. Fabricated of 18 gage steel, cabinets are 34 × 32 × 52 in.



DRYNESS

best reason in the world for using

genetron®
SUPER-DRY
REFRIGERANTS

"Genetron" Refrigerants are the ultimate in dryness. In "Genetron" 12, for example, there is less than one-thousandth of one percent of moisture! And the tight specifications for "Genetrons" are consistently *bettered* in production. That's why smart service engineers everywhere are insisting on Super-Dry "Genetrons."

Service? No matter where you are there's a "Genetron" wholesaler as near as your telephone. Make *your* next order—*"Genetron."*

QUICK FACTS on GENETRON Super-Dry Refrigerants

- Guaranteed exceptionally low moisture content.
- Noncorrosive to standard equipment materials, nontoxic, nonflammable, stable, safe.
- Critical and freezing points well outside range of operating uses.
- Solvent action on oil helps prevent solidification or congealing of lubricant; aids in lubrication of equipment; generally miscible with oil.
- Freely interchangeable and may be mixed in any proportions with comparable fluorinated hydrocarbons meeting the same strict refrigerant specifications.
- Available everywhere, from refrigeration wholesalers throughout the country.

GENETRON 11 ORANGE LABEL CCl_3F
Trichloromonofluoromethane

GENETRON 12 WHITE LABEL CCl_2F_2
Dichlorodifluoromethane

GENETRON 22 GREEN LABEL $CHClF_2$
Monochlorodifluoromethane

GENETRON 113 PURPLE LABEL $C_2Cl_3F_3$
Trichlorotrifluoroethane

GENETRON 114a BLUE LABEL $C_2Cl_2F_4$
Dichlorotetrafluoroethane

Allied Chemical

GENERAL CHEMICAL DIVISION

40 Rector Street, New York 6, New York

NEW

DOUBLE PLATED PROTECTION!...

ONLY BULLDOG *Pitches the Grip in the RIGHT DIRECTION*

BULLDOGS bite into concrete in seconds ... Anchor Anything Permanently!

BULLDOG *Gold Digger*

CONCRETE DRILL/ANCHORS

Here's far *more* for your concrete fastening dollar . . . *better* (double) plating with an *unmistakable* gold color finish . . . *plus* the best grip in the business.

Only Bulldog reverse-pitches the ridges to assure "the grip that never fails." Furthermore, Bulldogs are fireproof, vibration proof, safe, fast and easy to install. And *you save* the cost of special drills . . . and the time it takes to use them.

358,000 BULLDOGS USED IN BIG CANADIAN HOSPITAL

Three heliports crown St. Justine's Hospital in Montreal, one of the many big projects where Bulldog Drill/Anchors have been used.

ASK FOR NEW **Gold Digger** MANUAL

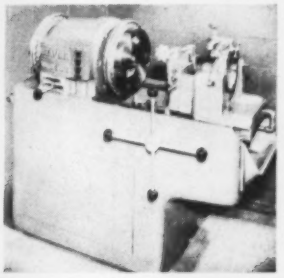
POLIS MFG. CO.
A Division of Gregory Industries
102-10 Toledo Ave.
Lorain, Ohio

☐ Rush sample of new Bulldog Gold Digger Drill/Anchor
☐ Include new Bulldog Manual
☐ Have your Representative call

NAME _____ TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

EQUIPMENT DEVELOPMENTS

Continued



Pipe Threading Machine . .

. . .designed to cut, thread, ream, groove, chamfer pipe—*Beaver Pipe Tools, Inc., Dept. HPAC,* 310 *Dana Ave., Warren, Ohio.*

"Beaver Speed-King" is ½ to 4 in. pipe and bolt threading machine that threads 2½ to 4 in. without changing dies. Unit has four spindle speeds 19 to 74 rpm. Lathe type cut-off tool bit that cuts, chamfers pipe in same operation. Unit weighs 980 lb.

Horizontal Boiler . . .

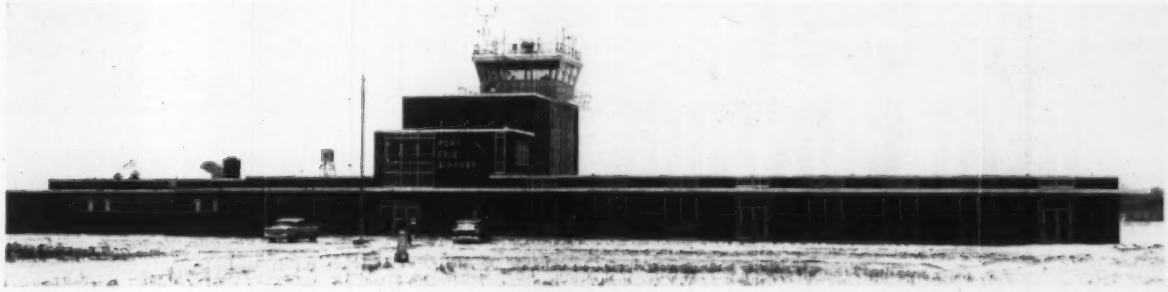
. . .for gas, oil or combination gas and oil—*Mears-Kans-Ofeldt, Inc., Div. of S. T. Johnson Co., Dept. HPAC, P. O. Box* 223, *Bridgeport, Pa.*

Unit has horizontal return tubular construction with rectangular combustion chamber. Built for operating steam pressures to 100 psi, or higher if required. Available in 6½, 15, 25, 33 hp sizes.

Welder Transformer . . .

. . .for a-c or d-c current applications —*Miller Electric Mfg. Co., Dept. HPAC,* 718 *S. Bounds St., Appleton, Wis.*

"Twin" welder on two a-c ranges (20 to 115 amp and 60 to 180 amp) and one d-c range (40 to 150 amp). Intended for field and small industrial applications.



AIRPORT SELECTS WEIL-McLAIN BOILERS FOR HEATING AND SNOW MELTING

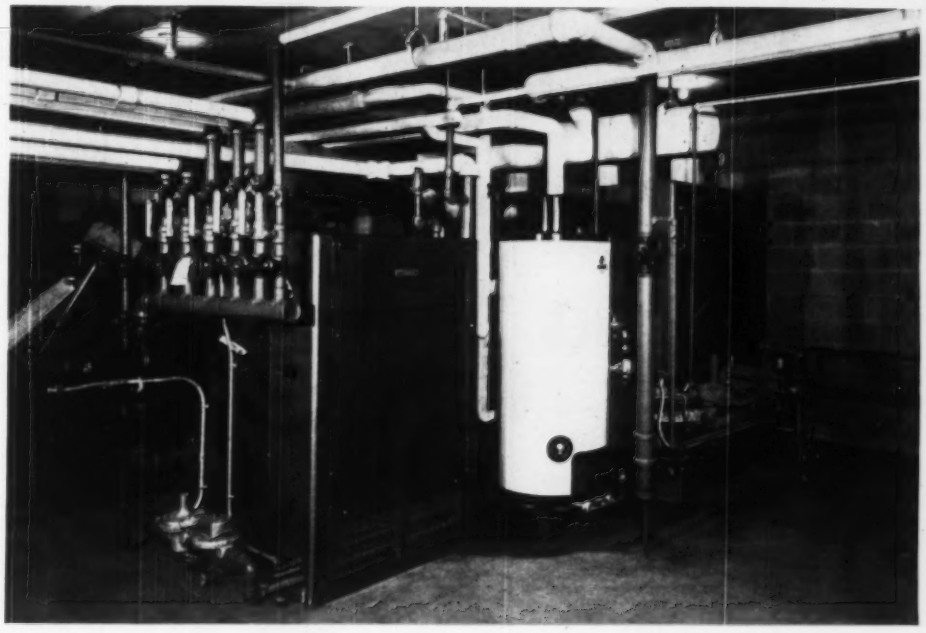
BUILDING:
Port Erie Airport,
Erie, Pa.

ARCHITECTS:
Nelson, Goldberg and
Heidt, Erie, Pa.

ENGINEER:
Don Kennedy

CONTRACTOR:
Wm. T. Spaeder
Engineering Co.

DISTRIBUTOR:
Case-Erie Supply Corp.



Send for engineering data on Weil-McLain Gas and Oil Boilers for Commercial and Industrial Heating Systems. Address Dept. AA-118

In this unusual installation, Weil-McLain Boilers were the choice to serve two airport needs. The "HR" Boiler at the right is used for space heating and the Type "J" Gas Boiler for the snow melting system. This arrangement, instead of the more conventional method of installing a snow melting system converter on a single boiler, was due to certain restrictions on the use of gas.

In the Erie, Pa., airport area, gas-fired space heating boilers above a certain size must be equipped to use a standby fuel. The Weil-McLain "HR" Boiler therefore has a combination oil and gas burner. In the event of a gas shortage, the "J" boiler handling the snow melting system would not operate, but the function of space heating could be continued by switching the "HR" boiler to oil firing.

This dual purpose installation also made a saving in original equipment cost.

WEIL-McLAIN
BOILERS · RADIATORS

WEIL-McLAIN COMPANY
MICHIGAN CITY, INDIANA

LOW-COST HEAT CONTROL

in every room

Fulton Sylphon

AUTOMATIC RADIATOR VALVES

Anyone can afford automatic room-by-room heat control using simple, dependable, low-cost Fulton Sylphon Automatic Radiator Valves. They cost less to buy . . . less to install . . . less to operate . . . in new installations or modernization of existing steam or hot water radiation systems. No electrical wiring, piping, or accessories to install. These self-operating packless valves throttle heat input *continuously* for maximum comfort and minimum fuel use. No. 885 valve shown is for exposed radiators, convectors, fin-tube radiation, etc. All valves may be specified in angle or globe patterns, sizes $\frac{1}{2}$" to 1$\frac{1}{2}$", and may be locked at any temperature setting to avoid tampering. Other valves and temperature regulators available for enclosed radiators, convectors, air conditioning system final (reheat) controls, and for certain types of year-round air conditioning systems. Write for complete information in Catalog SF-750.

Robertshaw-Fulton CONTROLS COMPANY

FULTON SYLPHON DIVISION • Knoxville 1, Tennessee

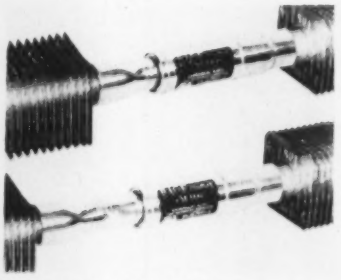
EQUIPMENT DEVELOPMENTS

Continued

Boiler-Burners . . .

. . . in four new sizes—*Edwards Engineering Corp., Dept. HPAC, 101 Alexander Ave., Pompton Plains, N. J.*

Four new models added to company's boiler-burner line include models with ratings 1200 to 4000 sq ft., ranging in gross output rates from 100,000 to 600,000 Btu per hr. All boilers have prepackaged and prewired components, may be obtained with completely pre-assembled, motorized zone control valves. Built-in automatic air elimination devices included in all boilers.



Expansion Coupler . . .

. . . designed to eleminate problems of expansion, contraction, noises, stresses, strains—*American Tube Products, Dept. HPAC, 100 Pulaski St., West Warwick, R. I.*

"Base Slide" expansion coupler has "piston slide design" said to provide three times more expansion than bellows type joints. Coupler will provide expansion, contraction movement of 100 lineal ft of baseboard radiation or copper tubing. Made of copper, available in five sizes $\frac{3}{4}$ to 2 in.

Arc Welders . . .

. . . available in three new models—*Air Reduction Sales Co., Div. of Air Reduction Co., Inc., 150 E. 42nd St., New York 17.*

"Aircomatic Fillerarc Welder" designed for applications in gas-shielded metal-arc processes. Current rating is 450 amp continuous; weight, 840 lb. "Hornet 36B" available in 300, 100 amp models designed for light.

EQUIPMENT DEVELOPMENTS

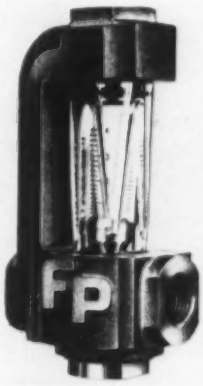
Continued

medium, heavy-duty d-c metal-arc and inert-gas-shielded arc welding. "Yellow Jacket" built in 300 and 400 amp sizes, recommended for pipeline and construction work in field.

Pillow Block . . .

. . . designed to meet requirements for varying overall dimensions—*Fafnir Bearing Co., Dept. HPAC, 37 Booth St., New Britain, Conn.*

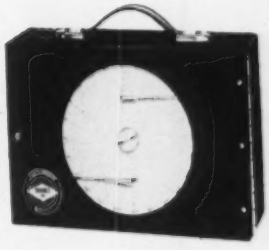
"LAKH" pillow block has wide inner ring ball bearing with company's "Merchani-Seal," as integral part of bearing keeping out lubricants and foreign matter. Bearing is self-aligning.



Flow Rate Indicator . . .

. . . in design using o-ring construction to seal metering tube—*Fischer & Porter Co., Dept. HPAC, 797 Jacksonville Rd., Hatboro, Pa.*

Design of unit simplifies cleaning, range changing, says manufacturer. Body is of one piece bronze construction. "Ratosight" flow rate meter recommended for measuring flow rates of bearing lubricants, coolants, etc. Available with vibrationproof alarm for high and/or low flows. Three meter sizes required to cover ranges from fraction of cc per min to 26 gpm of liquid, or 65 standard cu fpm of gas.



Humidity Recorder . . .

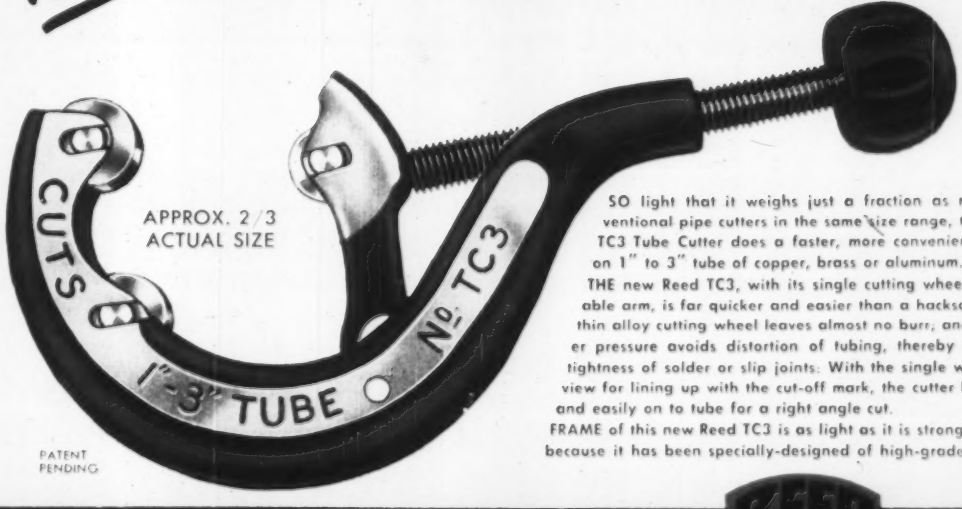
. . . designed for plant use—*Serdex, Inc., Dept. HPAC, 12 Beacon Sq., Boston 14.*

New line includes thermographs, hygrographs, hygrothermographs with unconditional one year guarantee. Hygrograph has company's patented animal membrane sensing element with ±5 percent accuracy

REED

● This new Reed Tube Cutter—a faster, lighter-weight roller cutter—is the first cutter for 1" to 3" copper tubing; equally ideal for brass and aluminum tubing from 1" to 3".

New TC3 TUBE CUTTER!



APPROX. 2/3 ACTUAL SIZE

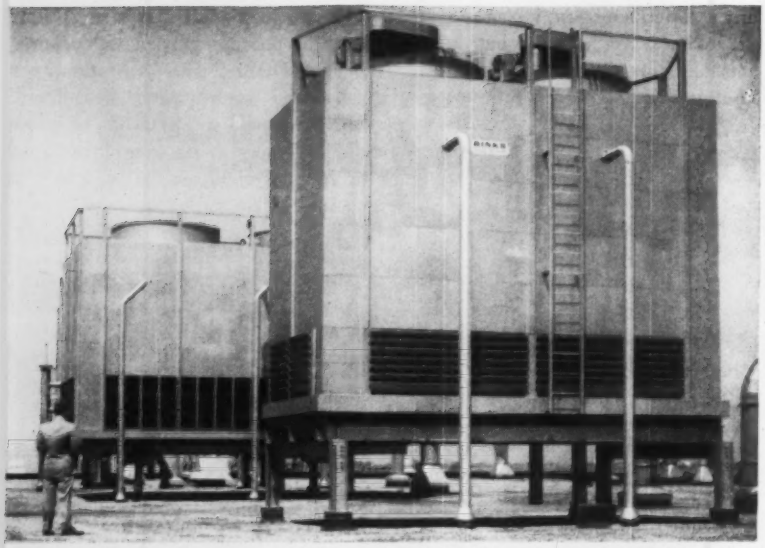
PATENT PENDING

SO light that it weighs just a fraction as much as conventional pipe cutters in the same size range, this new Reed TC3 Tube Cutter does a faster, more convenient cutting job on 1" to 3" tube of copper, brass or aluminum.

THE new Reed TC3, with its single cutting wheel in the movable arm, is far quicker and easier than a hacksaw; the ultra-thin alloy cutting wheel leaves almost no burr, and TC3's lighter pressure avoids distortion of tubing, thereby safeguarding tightness of solder or slip joints. With the single wheel in plain view for lining up with the cut-off mark, the cutter hooks quickly and easily on to tube for a right angle cut.

FRAME of this new Reed TC3 is as light as it is strong and durable because it has been specially-designed of high-grade ductile iron

REED MANUFACTURING COMPANY ERIE, PA., U.S.A.



At the new Caterpillar Tractor plant in Decatur, Illinois, four Binks 2-K Series cooling towers play important roles in the manufacturing processes.

at Caterpillar's Decatur plant

Binks towers keep heat treating under cool control

The tough muscles of steel that make "Cat" motor graders and wheel tractors dependable work horses are no accident. All vital parts go through scientifically controlled heat treat processes.

Binks cooling towers play an important part in this process by controlling the temperature of quenching oils and water. They are also used to cool water that circulates to cool bearings in the electric induction heat treat furnaces.

Failure of the cooling equipment could be costly.

Dependability you can count on

Binks cooling towers are built to rigid specifications. All panels and framework are heavily galvanized and coated for long life and minimum maintenance. Fans are corrosion-resistant aluminum alloy. Scientifically balanced air-to-water ratios give high cooling efficiency under all climatic conditions.

A complete line

Whether it is for cooling process fluids or for use with air conditioning compressors, there's a Binks cooling tower, of the correct capacity and type for every job.

Send for complete data

Ask your Binks branch office for a copy of Bulletin 333 and Bulletin 477-A or write direct to the address below. Binks engineers will be glad to answer your questions and help you solve your cooling problems. There's no obligation.

Binks
EVERYTHING FOR WATER COOLING

A COMPLETE LINE OF NATURAL DRAFT AND MECHANICAL DRAFT COOLING TOWERS AND INDUSTRIAL SPRAY NOZZLES

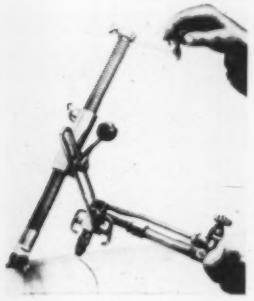
Binks Manufacturing Company
3118-38 Carroll Ave., Chicago 12, Ill.

REPRESENTATIVES IN PRINCIPAL U.S. & CANADIAN CITIES • SEE YOUR CLASSIFIED DIRECTORY

EQUIPMENT DEVELOPMENTS

Continued

over 15 to 95 percent RH range and 32 to 130 F temperature range. Correction chart adapts hygrograph to temperatures as low as −30 F. Ambient RH over 24 hr period can be graphed. Chart readable to 1 percent RH. Thermograph accurate within ±2 percent over range of zero to 100 F. Accuracy repeatable within ±2 percent of original calibration. Sensing element is bimetal coil type. Both units have choice of spring-wound or electric drive. Size is 10½ × 7 × 3 in.; weight is 4½ lb.



Pipe Cutter . . .

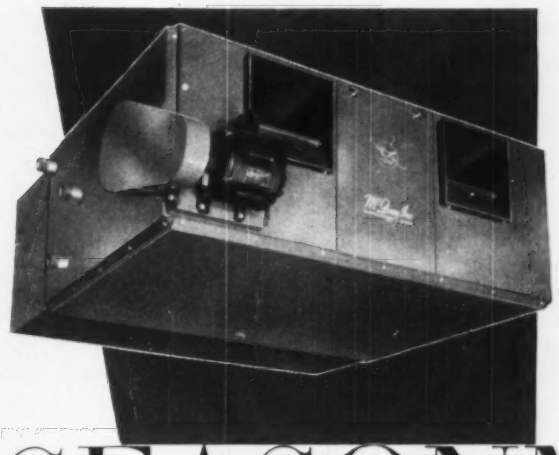
. . . in new line designed to cut holes, end protrusions—*Orbit Sales Co., Inc., Dept. HPAC,* 185 *Church St., New Haven, Conn.*

Applications for "VUS" flame cutting devices include cutting holes in intersecting pipes, tubes prior to welding joints. Cuts possible with unit include: straight end cuts, circular holes in cylindrical curved surfaces, vertical or inclined straight cuts, vertical circular holes in cylindrical shapes, changing value continuous end protrusions.

Time Switch . . .

. . . intended for commercial heating, ventilating, irregular operation—*Paragon Electric Co., Dept. HPAC,* 1609 12*th St., Two Rivers, Wis.*

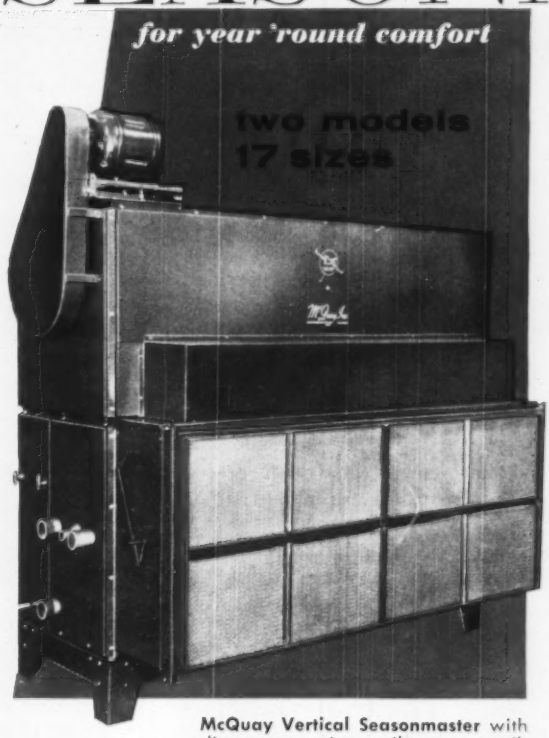
"1500 Series" time switch has 96 self-retaining trippers in 24 hr dial; operation for any 15 min period obtained by sliding tripper in or out with fingers. Can be supplied with holiday cut-out attachment geared to drive to prevent loss of synchronization.



McQuay Horizontal Seasonmaster with water coil, steam coil, face and by-pass, and flat filter section. Removable panels permit complete accessibility for inspection or service. Horizontal models available in 17 sizes, ranging from 640 to 38,100 cfm.

McQuay SEASONMASTERS

for year 'round comfort



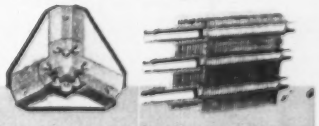
McQuay Vertical Seasonmaster with direct expansion coil, steam coil, face and by-pass, and flat filter section. Heavy gauge galvanized channel framework to form a rigid structure. Sixteen sizes are available, ranging from 640 to 29,000 cfm.

The most universal line of air conditioners in the industry

The McQuay line of Seasonmaster central station air conditioners is truly universal. It is the most versatile, the most flexible and the most complete in the industry. McQuay Seasonmaster units will both heat and cool, filter, humidify and dehumidify, when furnished with steam, water heating, water cooling or direct expansion coils in capacities from 640 to 38,100 cfm. A full line of accessories is available for any heating or cooling combination.

For small or large area air conditioning, look to McQuay. Compare the versatility, compare the quality and performance and compare the range of models. And always remember, only McQuay gives you Ripple-Fin coils, Dura-Frame construction and Galva-Seal bonderized, baked-on enamel finish. See the McQuay representative in or near your city or write McQuay, Inc., 1601 Broadway Street N. E., Minneapolis 13, Minnesota.

McQuay Means Quality



McQuay units feature the exclusive Ripple Fin Coils which create maximum air turbulence and have wide, full fin collars that act as automatic spacers to form a tube around the coil tube for positive, permanent bond, greatest heat transfer and protection. The Dura-Frame "V" channel construction provides the strength and rigidity necessary for quiet, trouble-free operation.

McQuay INC.

MAKE THE SEASONS COME TO YOU

AIR CONDITIONING • HEATING • REFRIGERATION

The Porcupine Who Became Very Sharp!

Once upon a time ...

there was a porcupine who often appeared somewhat needled. He had been buying outmoded disposable media filters that were expensive to use and very difficult to install.

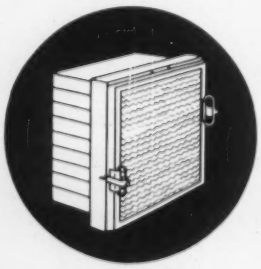
At first he felt it would be pointless to try the new, preformed Far-Air HP Filter which had become so popular, because of it's efficiency, economy, and convenience.

Then one day his friendly Far-Air man slipped a folded HP Filter right under his door. Mr. Porcupine got the point when he popped it open and realized how easy it would be to install. He specified HP filters because they solved his problem.

Now he's really sharp ... he's sticking with them.

Moral:

Compare before you specify. See the new Far-Air HP Filter. Take quill in hand and fill out the coupon below.



FARR COMPANY

NEW YORK LOS ANGELES CHICAGO

FARR COMPANY
P. O. BOX 45187 AIRPORT STATION
LOS ANGELES 45, CALIFORNIA

I see the point! Send me the full story on HP Filters. Bulletin 1300-2.

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COMPANY _____

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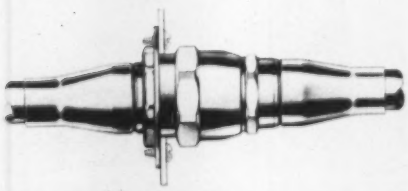
EQUIPMENT DEVELOPMENTS

Continued

Equipment, Building Insulation . . .

. . . with self-extinguishing ingredient—*Armstrong Cork Co., Dept. HPAC, Lancaster, Pa.*

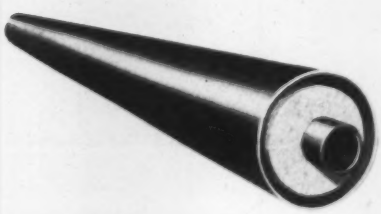
"SE Arma lite" polysterene foam insulation has density of 1.25 lb per cu ft. Self-extinguishing ingredient introduced early in manufacturing process. Material has *K* factor of 0.24 at 60 F mean temp. Material made in boards in standard sizes from 3 to 15 ft in length and 12 to 36 in. in width. Standard thicknesses: 1, 1½, 2, 3, 4, 6 in.



Refrigerant Coupling . . .

. . . developed for air conditioning and refrigeration applications—*Aeroquip Corp., Dept. HPAC, 300 S. East Ave., Jackson, Mich.*

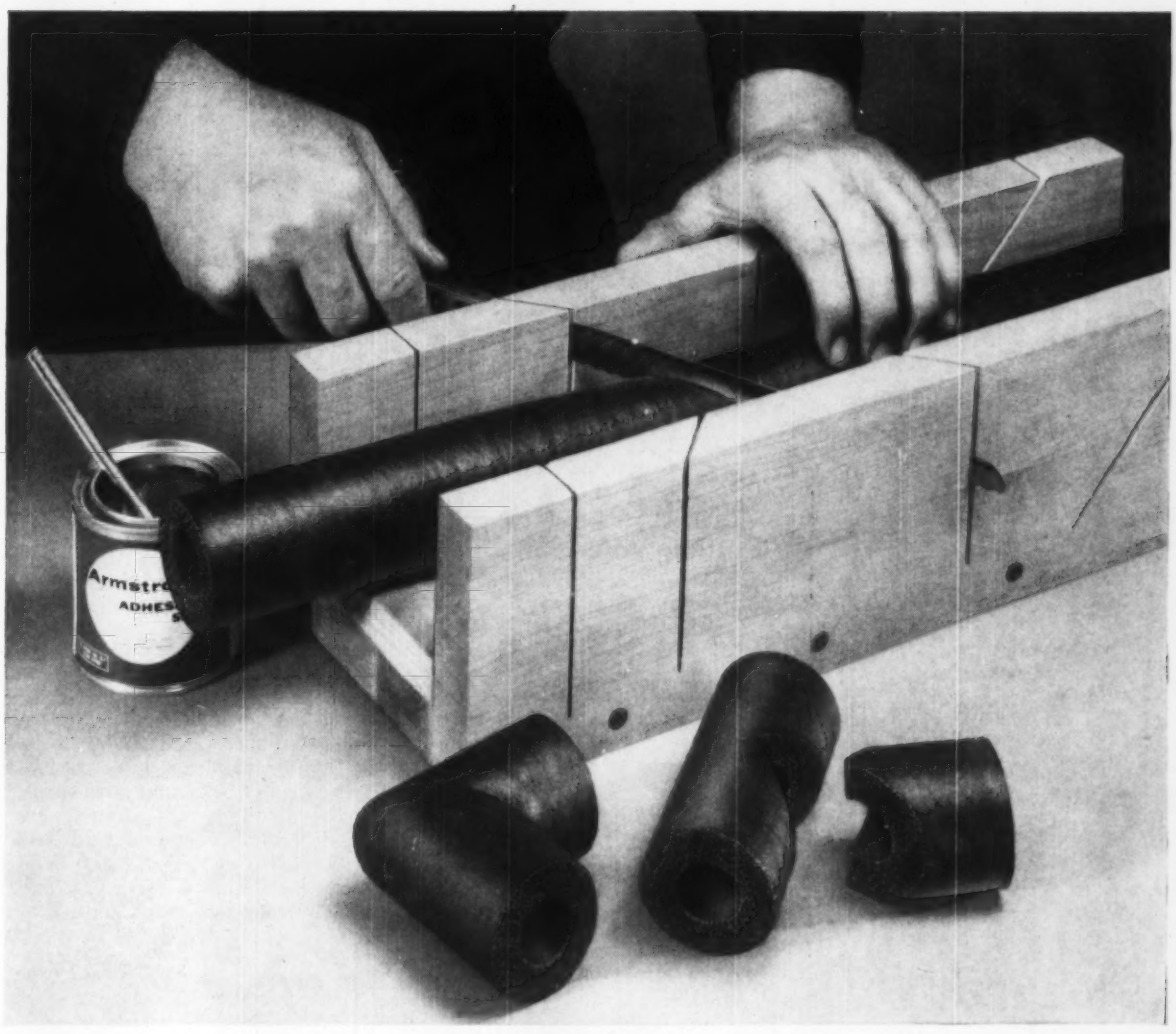
Coupling suitable for use with refrigerants including Nos. 12 and 22, similar compounds. "Series 5500" coupling said to be leakproof; when disconnected, coupling halves seal tight to prevent loss of refrigerant, admission of air or foreign particles in system.



Prefabricated Piping . . .

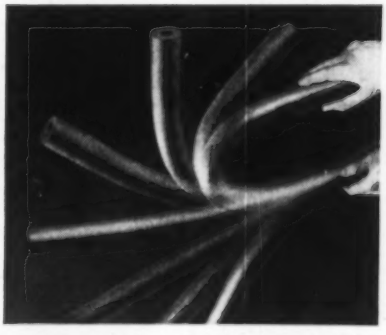
. . . developed for underground, overhead distribution of steam, hot water, oil, other viscous fluids, process fluids, refrigeration lines—*Portage Insulated Pipe Co., Dept. HPAC, 53 Antles Ave., Barberton, Ohio.*

Smooth wall piping systems factory prefabricated, including accessories and fittings. Units quickly installed with minimum of field work, says manufacturer. Units available for single and multiple insulated pipe systems.



A miter box and a sharp knife are all that are needed to fabricate fitting covers fast with Armaflex.

Insulate fittings 50% faster with Armstrong Armaflex Pipe Covering



Armaflex is extremely flexible, readily follows contours of pipes or bent tubing without special cutting and fitting.

The time it takes to insulate pipe fittings properly can drop 50% or more when Armstrong Armaflex is used. Armaflex is the new, cellular, flexible foamed plastic insulation that is completely waterproof and vaporproof. There's no waste, and it doesn't chip, crumble, or rub off.

To make fitting covers, the material is cut quickly and accurately with a sharp knife. The pieces then are cemented together with Armstrong 520 Adhesive, slit lengthwise, and snapped in place. Since Armaflex is the same vaporproof material that insulates the pipe run, there's no need to buy wrap-on coverings, cements, twine, tape, or waterproof coatings. One insulation does all the work.

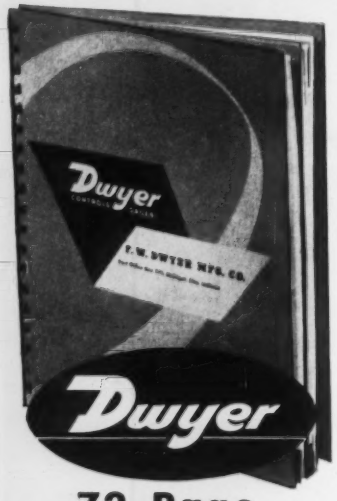
An Armaflex job is more than just fast. Fittings look neater, too. And the installation lasts indefinitely. Armaflex stays dry and efficient – will positively stop condensation when used in recommended thicknesses.

For full information on this remarkable pipe covering and complete instructions on how to apply it, write today to Armstrong Cork Company, 2211 Sherman St., Lancaster, Pennsylvania.

Armstrong INSULATIONS

FREE

to All Users of GAGES and CONTROLS



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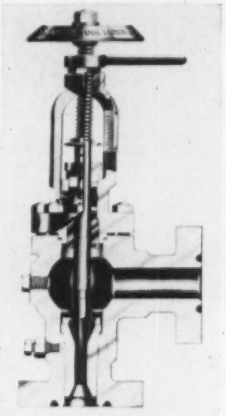
EQUIPMENT DEVELOPMENTS

Continued



Throttling Valve . . .

. . . developed for general industrial, chemical use—*Shaffer Tool Works, Dept. HPAC, 209 S. Pomona, Brea, Calif.*

Metering valve available in carbon steel, stainless steel, bronze or aluminum, sizes 1 to 6 in., pressure ratings to 10,000 psi in all sizes. Flanged or threaded connections optional. Outside threads of valve said to be corrosion resistant and stem may be locked at any setting. Pointer and calibration plate indicate amount of orifice opening.

Air Line Lubricator . . .

. . . with adjustments for both low and high cfm applications—*Emco Pneumatic Corp., Dept. HPAC, 1317-1319 Locust St., Des Moines, Iowa.*

Unit's principle of operation is acceleration of air to form oil mist as it passes through venturi. Air is filtered by centrifugal motion set up by air turbulance and by two monel

BUENSOD DUAL-DUCT UNITS, NOTED FOR FLEXIBILITY, CONDITION YEAR-AROUND

In the photograph on the facing page, the familiar tools of your profession symbolize the heart of one of the most flexible air conditioning systems ever developed. The system is the high pressure Dual-Duct method. Simply and efficiently it cools, heats, humidifies or dehumidifies a building. And it provides widely varying temperature and humidity conditions, where desired, from room to room.

The problem was to make such a system *stable*. Buensod engineers invented *direct, automatic volume control*. As pressures in the system change, each mixing unit automatically adjusts to maintain a constant quantity of air.

The action is something like the compass in our photograph on the adjacent page. That's how simple it is – but this is inspired simplicity, for the automatic volume control permits quick balancing of an entire system merely by adjusting spring tension at the time each unit is installed. Or we can pre-balance an entire system at our factory, saving time on your job.

Type V3 Air Mixing Unit for under window or wall mounting.

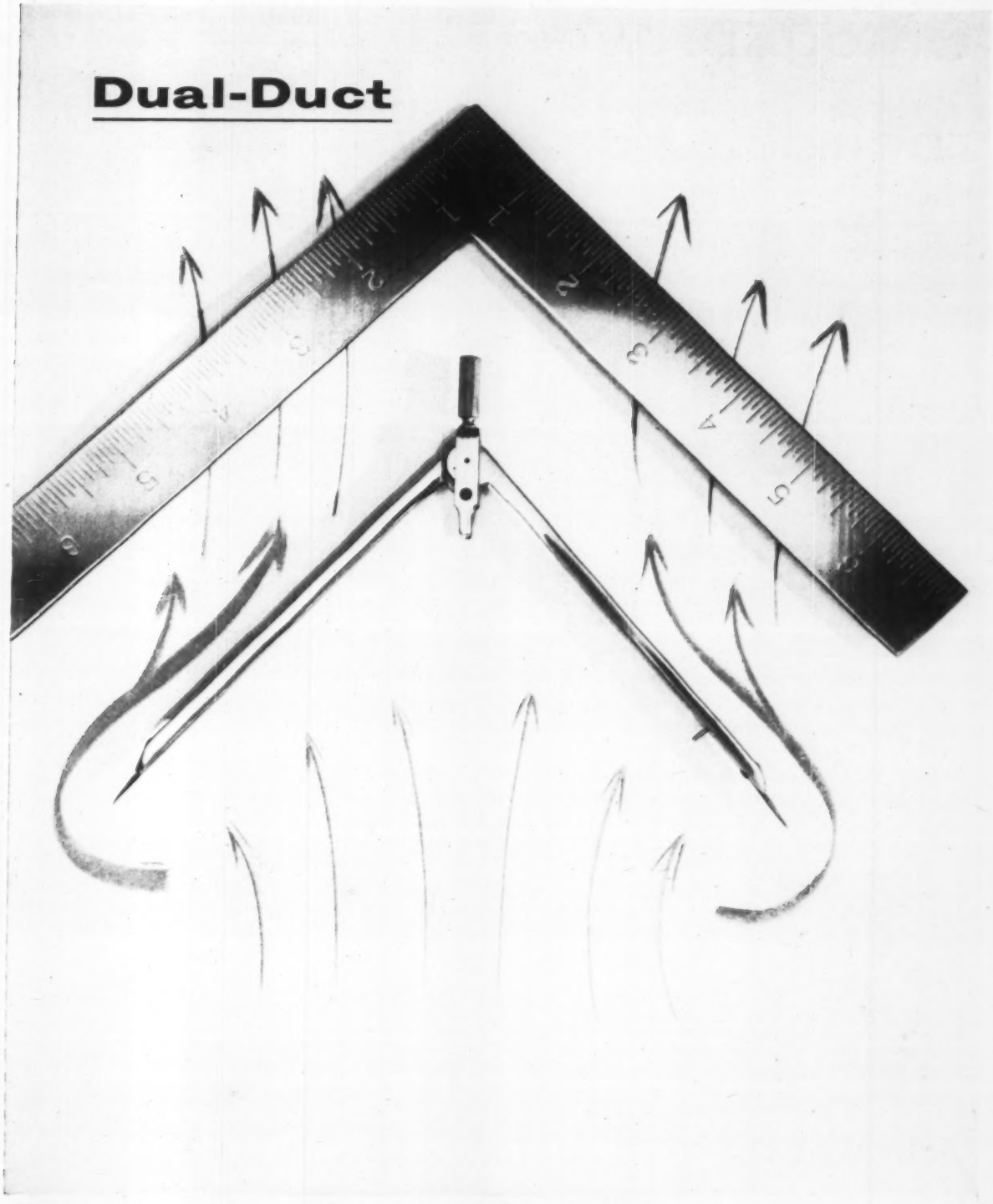
Type H unit for overhead installations

Buensod Dual-Duct Air Mixing Units offer true simplicity in air conditioning. We'd like to provide you with full technical details. Please contact our local representative, or write us directly.

BUENSOD-STACEY, INC.
45 West 18th Street • New York 11, N. Y.

BUENSOD-STACEY
INCORPORATED

SIM
in air



PLICITY
conditioning DESIGN

Smog proves recirculation pays

Smog is no problem at St. Vincent's Hospital, Los Angeles: activated charcoal purifies inside air for recirculation. Air conditioning and ventilating loads are reduced at substantial savings. Inside air is always "fresh" and odor-free, regardless of outside air contamination.

Whatever your air conditioning requirements, it will pay you to evaluate the savings—reduced investment in equipment *and* operating costs—from air purification with activated charcoal.

Write for Bulletin T-318. Barnebey-Cheney, Columbus 19, Ohio.

Barnebey-Cheney PurAir filters are easily installed and replaced as needed. St. Vincent's Hospital has 49 "cells," each handling 1000 cfm.

activated charcoal air purification

Barnebey Cheney

EQUIPMENT DEVELOPMENTS
Continued

filter screens. Pipe sizes range ¼ to ½ in. with maximum cfm at 90 psi from 20 to 70 cfm. Maximum inlet pressure is 250 psi.

Flow Rate Transmitter . . .

. . . developed to use magnetic method to convert the motion of rotameter metering float into rotary motion for flow rate indication, transmission, alarm—*Brooks Rotameter Co., Dept. HPAC, P. O. Box 432, Lansdale, Pa.*

"MPT-50" is indicator for all-metal or "blind" rotameters. Magnetic linkage between metering float and indicator cannot be broken, says manufacturer. Flow sensing cam fixed to top of magnetic position converter. Mounted alongside is pneumatic cam follower similar to tracing head. As metering float moves, flow sensing cam is turned and pneumatic cam follower traces leading edge of cam, transmits air signal corresponding to position or flow rate. Unit unaffected by vibration, wide temperature variations, air pressure variations 20 to 25 psi.

Water Mixing Valves . . .

. . . intended for commercial and restaurant applications—*Patrol Valve Co., Dept. HPAC, 2310 Superior Ave., Cleveland 14.*

"Model EV-A" is adjustable, supplied in 70 to 130 F or 120 to 165 F ranges. "Model EV-N" is non-adjustable, supplied set at either 80 or 140 F. Both models available in either ½ or ¾ in. mixed water outlets; hot and cold inlets fitted with manufacturer's "Dielectric Insulating Unions"

TRADE FRICK MARK®

Air Conditioning & Refrigeration

Serving the Great BARNES HOSPITAL . . . WASHINGTON UNIV. MEDICAL CENTER at St. Louis, Mo.

7½-Ton Frick unit air conditioner serving four research and lecture rooms.

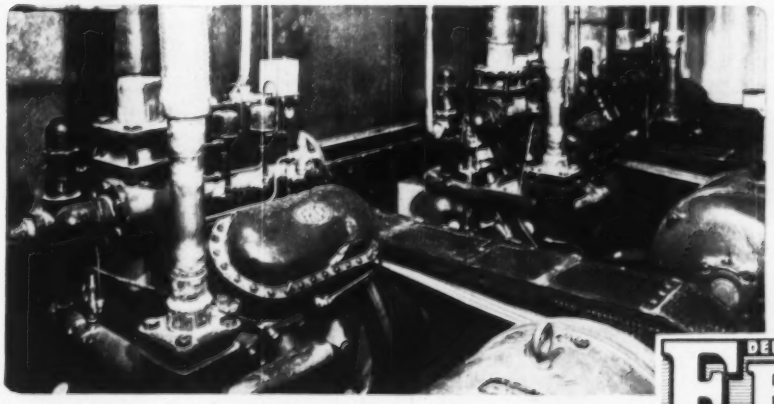
Here 11 Frick unit air conditioners and 42 Frick compressors supply the necessary cooling services for operating rooms, private rooms, auditorium and chapel, class rooms, nurse-interns' dormitories, offices, libraries, laboratories, cafeterias, kitchens, special freezers, research departments, morgues, animal rooms, etc. Installation by L. V. Fleiter Co., Inc., Frick Distributors in St. Louis, Missouri.

Whether you need conditioned air, cold water, ice, cold rooms, or very low temperatures,—for human comfort, food service, process work, quick freezing, research, or any other commercial or industrial purpose,—there's a Frick system to meet your exact requirements.

Let us quote now on the equipment you need.

Our Booth at the International Heating & Air Conditioning Exposition is 309.

Write . . .
wire . . . phone or visit.



Three Frick "ECLIPSE" compressors which air condition several operating rooms at Barnes Hospital, St. Louis.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA., U. S. A.

Society for Savings and Hartford National Bank & Trust Co.

West Hartford, Conn.

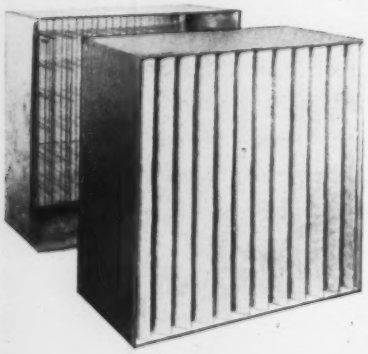
ARCHITECT	ENGINEER	GENERAL CONTRACTOR	VENTILATION CONTRACTOR
Jeter and Cook Hartford, Conn.	Van Zelm Associates West Hartford, Conn.	Industrial Construction Co. Hartford, Conn.	Homestead Insulation Co. East Hartford, Conn.

Unique Modern Banking Center Keeps Interior Bright and Clean with Cambridge AEROSOLVE® 85 Filters

An outstanding feature of this new banking center is the extensive use of colorful fabrics and bright walls and fixtures. Cambridge AEROSOLVE 85 Filters were selected to preserve the bright colors and avoid excessive maintenance costs by removing visible dust as well as the smudge-producing invisible particles which go right through ordinary filters.

Filters Serviceable Upstream or Downstream

Each bank in this center has its own air-conditioning system. In one, the AEROSOLVE filters are serviced from the upstream side; in the other, from downstream — a design feature which greatly simplified the air-conditioning layout.



Easy Servicing

The replaceable cartridges are held in permanent cadmium-plated frames and are secured by quick-acting fasteners. Beyond infrequent cartridge replacement, AEROSOLVE filters require no servicing or maintenance.

Flexibility to Meet Changing Needs

While AEROSOLVE 85 filters were installed as most suitable for the existing requirements, provision is made for changing to cartridges of higher or lower cleaning efficiencies as future conditions require. If dirt conditions in the atmosphere should become more severe, AEROSOLVE 95 filters can be substituted. Conversely, if filters of lower efficiency should prove adequate, AEROSOLVE 35 cartridges can be substituted. All AEROSOLVE cartridges are interchangeable.

Write for Bulletin 502

Cambridge Filter Corporation

732 E. Erie Blvd., Syracuse 1, N. Y.

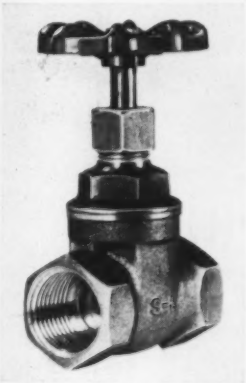
Pioneers in High Efficiency Filtration

REPRESENTATIVES IN PRINCIPAL CITIES

EQUIPMENT DEVELOPMENTS

Continued

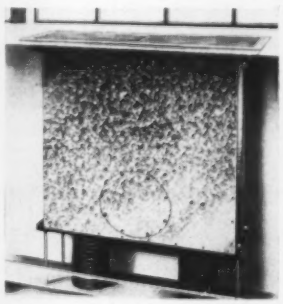
in choice of sizes, and sweat or NPT connections. Mixing valve kit, "Model EV-K" provides piping elbows, crosses, pressure relief valve, "Model EV-A" mixing valve ready for installation.



Gate Valves . . .

. . .available in iron and copper—*Price Pfister Brass Mfg. Co., Dept. HPAC,* 3011 *Humboldt St., Los Angeles* 31.

Range of sizes includes: ½, ¾, 1, 1¼, 1½ and 2 in. Features cited: non-rising stem; large packing gland; full acme thread. Valves designed to accept water pressure of 125 psi.



Valve Attenuator . . .

. . .engineered for quick installation, removal—*Connor Engineering Corp., Dept. HPAC, Danbury, Conn.*

Dual duct valve attenuator completely enclosed in wall, clamped to mounting plate by toggle bolts. By loosening bolts, unit can be removed from base plate through top discharge grille opening. In range of sizes.

Every engineer should know how

Chrysler's Airtemp Controls

the 3 "Secret Costs" of Air Conditioning

"SECRET COSTS" can mount up FAST . . . your best insurance is . . . Airtemp experience.

Unexpected costs never yet made a happy client—and your reputation can well depend on the equipment you choose. When you specify Chrysler AIRTEMP, your client pays *far less* in the long run. First, because AIRTEMP has the correct equipment for any size or kind of installation. Second, it minimizes these three "secret costs" of air conditioning:

1. THE SECRET COST OF WRONG EQUIPMENT
The wrong equipment can be troublesome as well as costly to operate. Airtemp makes all kinds of air conditioners—over 297 models—and can advise you which is best for your client's needs. *You're sure to get exactly the right equipment from Airtemp.*

2. THE SECRET COST OF OPERATION
Operating costs over a few years may actually exceed the first cost of air conditioning. But rock-bottom operating costs can save you substantial sums. That's why you should know that AIRTEMP—thanks to Chrysler engineering—promises *the lowest operating costs in the industry!*

3. THE SECRET COST OF MAINTENANCE
Maintenance costs and repair costs can be a shock. A breakdown brings repair bills plus the cost of lost time, lost business. But Airtemp air conditioning is carefully engineered by Chrysler for trouble-proof operation. And Airtemp is installed only by qualified contractors, who must certify to Airtemp that equipment warranted for 5 years has been installed properly. *That's why Airtemp maintenance costs average out to be the lowest in the industry!*

Ask us for the complete facts. Just mail the coupon below, and they'll be on their way to you at once. Or, phone your nearest Airtemp contractor or dealer who is listed in the Yellow Pages.

CHRYSLER

Airtemp

AIRTEMP DIVISION, CHRYSLER CORPORATION
Dept. HP-11-58, Dayton 1, Ohio
We would like the full facts on how Airtemp controls the 3 "secret costs" of air conditioning.

Name _____
Address _____
City _____ Zone ____ State _____
Firm Name _____

LOOK
at the
Advantages of
Van-Cor
PIPE, FITTINGS, VALVES

Van-Cor is an unplasticized polyvinyl chloride that resists the corrosive action of hundreds of industrial acids and alkalis as well as sewage waste and brine. Van-Cor piping costs less, is lighter in weight, and easier to install than conventional pipe. It is readily formed, machined, threaded and welded. Available in normal and high impact types. On many installations where metallic piping was eaten up *in a few months,* Van-Cor pipe has served *for years without deterioration.* Thus it quickly returns its cost and pays handsome dividends.

Van-Cor sheets are also fabricated into ducts, hoods, chemical tanks, fume-stacks, etc.

Write for Catalog and Name of Nearest Distributor

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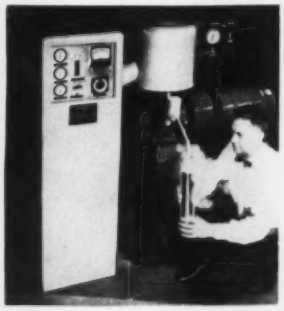
COLONIAL PLASTICS MFG. CO.
Subsidiary of THE VAN DORN IRON WORKS CO.
2685 EAST 79TH STREET CLEVELAND 4, OHIO

EQUIPMENT DEVELOPMENTS

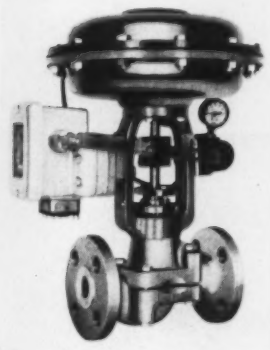
Continued



Liquid Nitrogen Generator

. . . with automatic controls intended to permit extended operation without attention—*Arthur D. Little, Inc., Dept. HPAC, 20 Acorn Park, Cambridge 40, Mass.*

Components of unit include nitrogen column, gas liquifier, 200 liter storage tank. Generator will automatically provide up to 95 liters of 99.5 percent pure liquid nitrogen daily, says manufacturer.



Control Valve . . .

. . . with springless diaphragm motor operator with preformed nylon diaphragms—*Uniflow Valve Corp., Dept. HPAC, 19 Quine St., Cranford, N. J.*

"Type 1000" has newly designed split body in sizes 1 through 6 in., available in steel, stainless steel, monel and alloy. Design said to eliminate erratic pressure variations in flow stream.

Shaded-Pole Motors . . .

. . . with double-shaft extensions as standard equipment—*Federal Electric Co., Dept. HPAC, Schenectady 5, N. Y.*

no tenants on the telephone with costly call-back problems

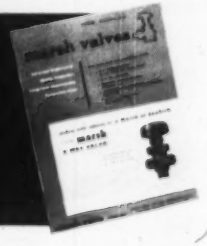
Marsh Valves protect profits for every member of the building team with trouble-free service for 250 apartments

Co-owners: J. J. MACK and RAYMOND SHER
Architects: HAUSNER & MACSAI
Mechanical Engineer: WILLIAM GOODMAN
General Contractor:
CRANE CONSTRUCTION COMPANY, INC.
Heating Contractor:
PLONSKER ENGINEERING COMPANY

1150 Lake Shore Drive, Chicago, Illinois . . . Circular 250 unit apartment building with one and two bedroom studio apartments.

Vital to any heating, water or air conditioning system is the use of competitively priced equipment which will protect profits over the years by minimizing call backs and post-installation service. That's why Marsh Valves were chosen for this modern 250-apartment building on Chicago's Lake Shore Drive. Over 500 — ½" Marsh Fig. 129-CC Convector Gate Valves with copper to copper connections were used in the heating system for this building. Marsh Valves mean continuous comfort for the tenants . . . and the comforting assurance for the owners and contractors that high quality, dependable Marsh Valves will provide long-run, year-in, year-out economy.

Specify, order or buy Valves by Marsh of Dunkirk for every job — large or small. You, too, can depend on Marsh Valves for quality and competitive price.



For a copy of the latest Marsh Catalog, consult your Marsh representative or write

Marsh Valve COMPANY
OF DUNKIRK, NEW YORK, U.S.A.

"ENTERPRISE Burners perform to our fullest expectations —year after year"

Says Otto Walters, Head Custodian, Capuchino High School, San Bruno, Calif.

Users, Engineers, Contractors—all agree:

"Everyone Benefits When It's an Enterprise"

The man who's on the job with heating operations day after day has the facts. At the modern, two-level Capuchino High School facility—which includes fifty-one class rooms, heated pool, gym, theater, auditorium, cafeteria, shops and kitchen—this man is Head Custodian Otto Walters. His four Enterprise Burners have delivered smooth, trouble-free service for both class rooms and hot water needs 5 days a week for nearly eight years.

On-the-job performance such as this naturally scores big with everyone down the line—dealer, engineer, contractor and user. Check the facts—you'll learn that the men who specify and work with Enterprise have found the best burner buy!

Fit your specifications to the *right* burner model from the complete range of Enterprise Burner sizes shown here:

HORIZONTAL ROTARY OIL BURNERS, & COMBINATION OIL & GAS BURNERS

INPUT				OUTPUT		
Burner Size	Motor HP	Oil-GPH Max	Gas CF/HR	Steam LBS/HR	Steam BHP	Radiation-Sq. Ft. Steam
AA	½	4	600	464	13	1880
A	½	7	1050	812	23	3280
C	½	15	2250	1740	50	7050
E	½	20	3000	2320	67	9400
F	¾	30	4500	3480	100	14100
G	1	35	5250	4060	118	16400
H	1	50	7500	5800	168	23400
H	1½	60	9000	6960	201	28200
J	2	75	11250	8700	250	35250
K	3	100	15000	11600	336	46900
L	3	135	20250	15660	453	63400
M	5	200	30000	23200	672	94000

The Choice of Heating Experts

ENTERPRISE

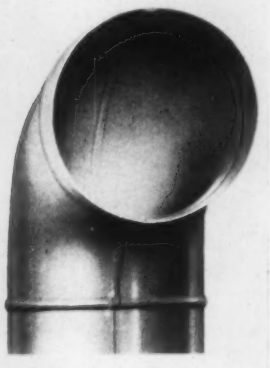
DEPENDABLE BURNERS

ENTERPRISE ENGINE & MACHINERY CO. • 18TH AND FLORIDA STS., SAN FRANCISCO, CALIFORNIA

EQUIPMENT DEVELOPMENTS

Continued

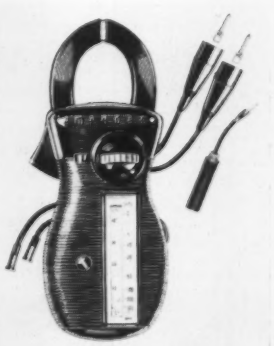
Motor can be mounted with through-bolts, bands or resilient rings. Available in ratings to ⅛ hp. Motor has forced lubrication and steel backed babbitt bearings; also has ventilation openings in shell and end shields. Unit has one, two or three speeds in either direction or both, depending on requirements.



Duct Elbow . . .

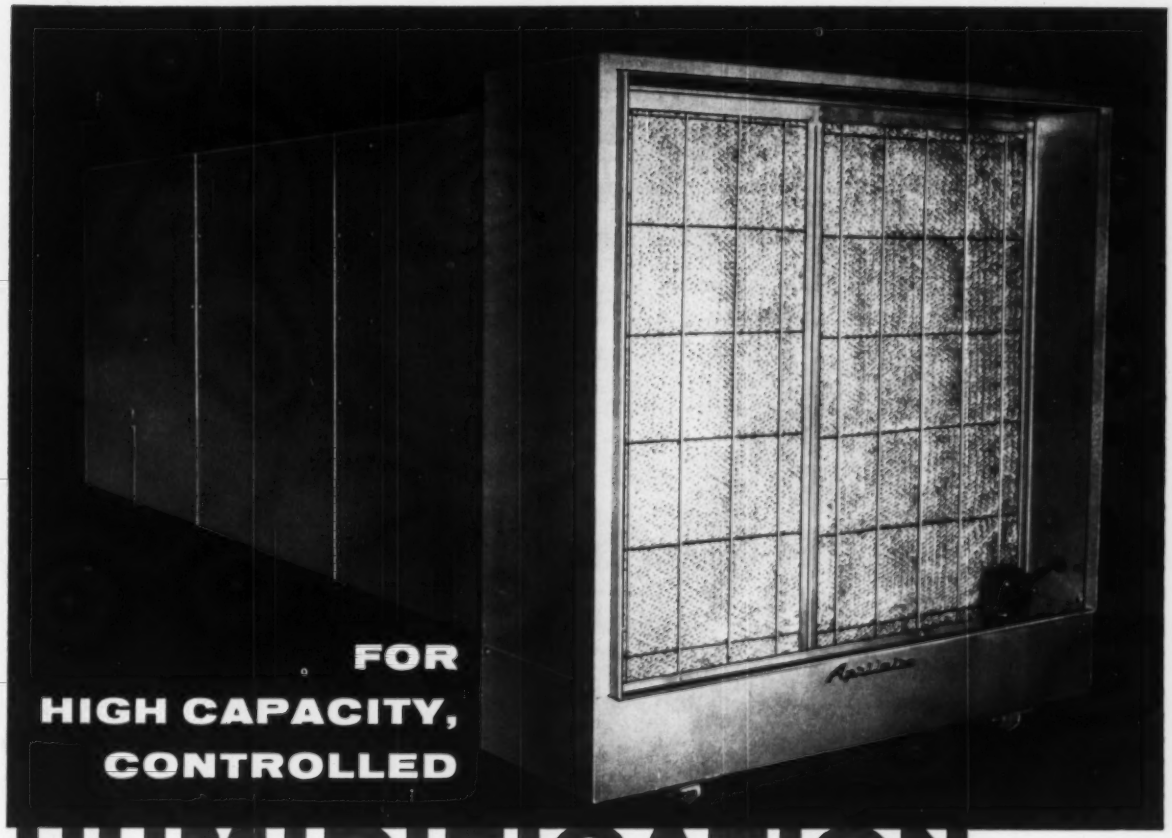
. . . designed to reduce friction loss and static pressure in high velocity air movement systems—*United Sheet Metal Co., Inc., Dept. HPAC, 540 S. Drexel Ave., Columbus 9, Ohio.*

Die-stamped, two-piece "Laminair-Flo" 90 deg elbows made of 20 gage galvanized steel in uniform size diameters of 3, 4, 5, 6, 7, 8 in. Two welded, die stamped sections form 90 deg elbows.



Volt-Ammeter-Ohmmeter

. . . developed to measure current, voltage, resistance—*Amprobe Div., Pyramid Instrument Corp., Dept. HPAC, 630 Merrick Rd., Lynbrook, N. Y.*



FOR HIGH CAPACITY, CONTROLLED

HUMIDIFICATION

RP **Aprilaire**

AUTOMATIC-ELECTRIC HUMIDIFIERS

HIGH CAPACITY

Aprilaire Industrial Humidifiers (illustrated) are designed to provide capacity for practically any size requirements. Unit sizes up to 10 G.P.H. — can be installed singly or in a series of any number of units.

POSITIVE CONTROL

The Aprilaire introduces relative humidity as needed . . . and only when needed. Automatic control eliminates possibility of lag or over-run.

FLEXIBILITY

Aprilaire industrial models are easily installed packaged units. Available for gas, steam or hot water heat source, every model can be pedestal-mounted or suspended — according to individual requirements.

BACTERIA REMOVAL

Super-clean air, carrying moisture in vapor form only, is delivered by the Aprilaire's unique principle, incorporating the use of air filters and mineral coated evaporating elements. This exclusive humidification method removes up to 70% of the bacteria in the air stream circulating through the unit.

ISOTHERMAL OPERATION

The Industrial Aprilaire has no temperature effect on the humidified air. Exhausted, humidified air is discharged at the same temperature it enters the unit.

MINIMUM MAINTENANCE

Because the only liming or water solids deposits occur on the inexpensive, replaceable evaporating elements . . . mechanical difficulties from these usually troublesome deposits are eliminated.

INDUSTRIAL AND RESIDENTIAL MODELS AVAILABLE–WRITE FOR COMPLETE INFORMATION

see our catalog in $ PLANT ENGINEERING FILE or write for copy

RP . . . PRODUCTS OF RESEARCH

RESEARCH PRODUCTS *Corporation*

Dept. 912, Madison 10, Wisconsin

Costs Less Because It Gives the Most in Service

When selecting unions it will pay you to remember 2 things: (1) Darts can be used over and over again — on location after location (2) On location after location, they give a drop-tight seal. How can you beat this combination for economy . . . at any price?

QUICK FACTS

- Extra wide bronze seats resist pitting and corrosion
- Nut and body of air-refined, high test malleable iron are practically unbreakable
- Heavy shoulders can withstand the toughest wrench abuse
- Each Dart is individually vacuum-tested

DART UNIONS *Products of* DART UNION COMPANY PROVIDENCE 5, R.I.

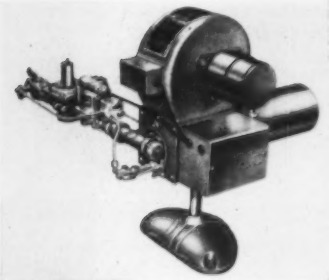
GENERAL SALES AGENT

THE **Fairbanks** COMPANY
393 LAFAYETTE STREET, NEW YORK 3, NEW YORK
BRANCHES: NEW YORK 3
PITTSBURGH 22 • BOSTON 10 • ROME, GEORGIA

AVAILABLE THROUGH YOUR LOCAL DISTRIBUTOR

EQUIPMENT DEVELOPMENTS
Continued

"RS-3" intended for wide range of applications, including: spotting motor overloads, underloads; measuring voltage at motor terminals; setting overload relays; load balancing; determining starting current of motors; measuring resistance of coils; others. Model has built-in recessed range selector, permitting easy selection of ranges, says manufacturer. Five ammeter ranges: from zero to 5 to zero to 300; three voltage ranges: from zero to 150 to zero to 600; Ohmmeter range: 250 Ohms mid-scale.



Gas Burners . . .

. . .in five new models in expanded line from 70,000 to 700,000 Btu per hr—*Hastings Air Control, Inc., Dept. HPAC, 3215 Leavenworth St., Omaha* 5.

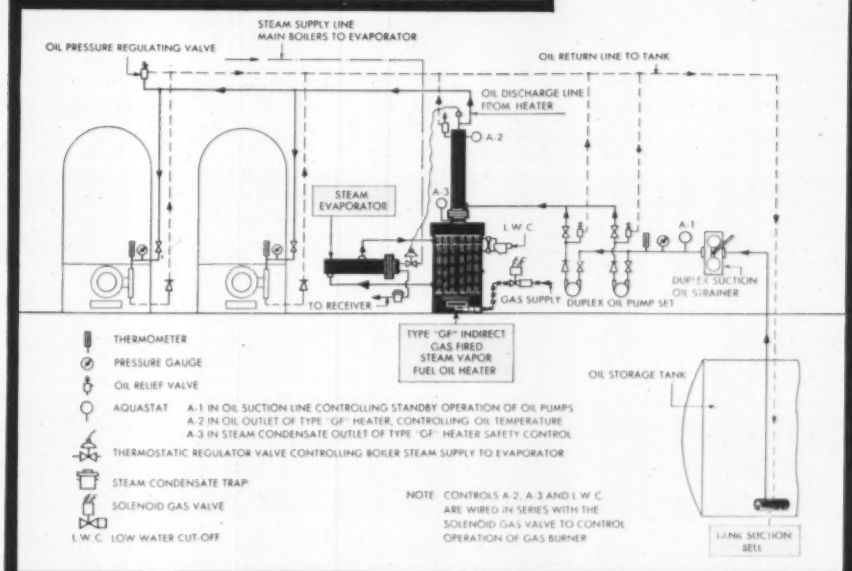
Features of new gas burners cited by manufacturer include: primary air adjustment; air switch to delay opening of gas valve until blower comes up to speed; plug-in type shut-off in case of pilot flame failure. Burners through 400,000 Btu per hr specifically designed to convert oil or coal heating plants to natural, LP or mixed gas.

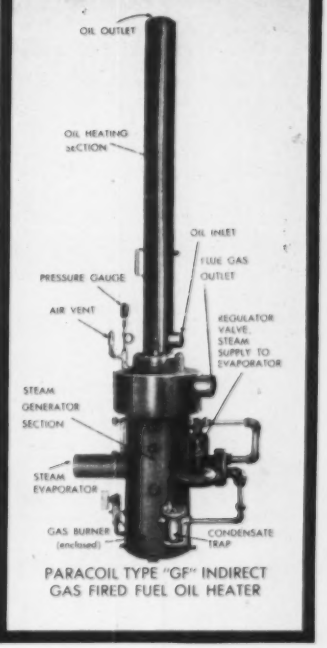
Metal Air Filter . . .

. . .with copper media—*Viking Air Products, Dept. HPAC, 5601 Walworth Ave., Cleveland* 2.

Copper media or core material does not require coating and cleans with vacuum cleaner, says manufacturer. Corrugated aluminum entry grid holds media in place, said to permit "depth load." Back of filter supported by corrugated aluminum screen; edges are aluminum channel.

Idea no. 3 from Paracoil


STEAM SUPPLY LINE
MAIN BOILERS TO EVAPORATOR
OIL PRESSURE REGULATING VALVE
OIL RETURN LINE TO TANK
OIL DISCHARGE LINE FROM HEATER
A-2
A-3
STEAM EVAPORATOR
L.W.C.
A-1
DUPLEX SUCTION OIL STRAINER
TO RECEIVER
GAS SUPPLY
DUPLEX OIL PUMP SET
TYPE "GF" INDIRECT GAS FIRED STEAM VAPOR FUEL OIL HEATER
OIL STORAGE TANK
THERMOMETER
PRESSURE GAUGE
OIL RELIEF VALVE
AQUASTAT
A-1 IN OIL SUCTION LINE CONTROLLING STANDBY OPERATION OF OIL PUMPS
A-2 IN OIL OUTLET OF TYPE "GF" HEATER, CONTROLLING OIL TEMPERATURE
A-3 IN STEAM CONDENSATE OUTLET OF TYPE "GF" HEATER SAFETY CONTROL
THERMOSTATIC REGULATOR VALVE CONTROLLING BOILER STEAM SUPPLY TO EVAPORATOR
STEAM CONDENSATE TRAP
SOLENOID GAS VALVE
L.W.C. LOW WATER CUT-OFF
NOTE CONTROLS A-2, A-3 AND L.W.C. ARE WIRED IN SERIES WITH THE SOLENOID GAS VALVE TO CONTROL OPERATION OF GAS BURNER
TANK SUCTION BELL



PARACOIL TYPE "GF" INDIRECT GAS FIRED FUEL OIL HEATER

Preheat No. 6 Oil with Safety, using BOILER STEAM and AUXILIARY GAS-GENERATED STEAM Installation and Operation are less costly!

- ***High operation costs of an all-electric No. 6 oil preheating system can be avoided by use of the Type "GF" Indirect Gas Fired Fuel Oil Heater!***
- ***No flame is in contact with oil tubes! Gas is used to generate a supply of steam to heat the oil.***
- ***Secondary evaporator eliminates use of gas entirely when main boiler is operating.***
- ***High viscosity oils are always maintained at atomizing temperatures.***

cut along dotted line and save

The Problem

Many No. 6 fuel oil burner systems operate on weekdays only, shutting down in whole or part over weekends and holidays. In such installations, special facilities are necessary to maintain adequate oil temperatures during the standby hours to enable the burners to start promptly and easily when the working period resumes.

In a typical standby system, oil is circulated by intermittent pumping between the burners and the storage tanks and is heated either by periodic boiler firing or by an all-electric system. Both are effective—but boiler heating necessitates firing a large boiler under most inefficient conditions, while an electrical system is extremely costly both to install and operate.

The Solution

Fast, effective, economical standby heating can be provided by a Paracoil system employing a **gas fired heater** (Type "GF"), a **tank suction bell** and a **secondary steam evaporator.**

The Gas-Fired Heater. The Paracoil "GF" Heater always maintains oil in its oil heater section at the proper burning temperature. This heated oil is always available for immediate circulation when needed to maintain pumping temperature in the oil circulation lines or when required to start the oil burners. In addition to maintaining oil at the proper burning temperature, the "GF" heater combined with secondary evaporator serves as a safety device which isolates the oil heater from contact with the primary steam generating system. Thus it is impossible to contaminate the main steam system or boilers with oil in event of an oil tube failure.

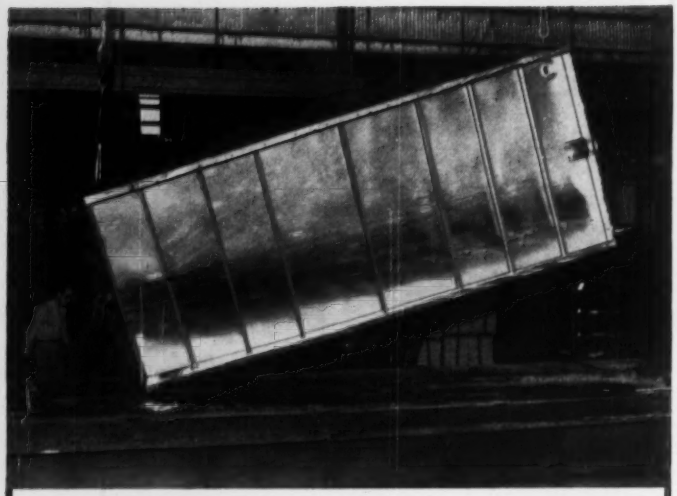
Tank Suction Bell. Heated oil is recirculated to a suction bell in the storage tank. Here it mixes with and heats oil to be withdrawn, maintaining a ready supply of fuel at pumping temperatures at all times.

Steam Evaporator. When the main boiler is in operation, boiler steam enters the steam evaporator and generates secondary steam which then takes over the fuel oil heating load. Concurrently, the Type "GF" heater cuts out, thus conserving gas when steam is available from the main boiler.

Paracoil engineers have designed and built many safety-type oil preheating systems. Their experience and know-how is at your service. Write for further information.

DAVIS ENGINEERING CORPORATION

30 Rockefeller Plaza, New York 20, New York • Circle 6-5650



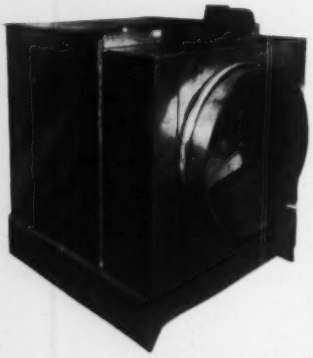
All Havens' tower casings, from the largest to the smallest models, are double-dipped after fabrication and before assembly. 100 Ton "V" series water basin is shown above after removal from the galvanizing kettle.

GALVANIZING THAT ADDS YEARS OF SERVICE LIFE TO

Havens Towers

Rigorous service and field tests adequately prove that heavy zinc coatings provide protection against rust for many, many years. Havens' specialized galvanizing process utilizes acid dipping, zinc ammonium chloride pre-flux and unhurried hot dip. The dip kettle is 50 inches wide, 60 inches deep and 25 feet in length. A quarter of a million pounds of molten zinc are maintained at 840° F. Material being galvanized is left in the dip until temperature is equalized. Over 2 ounces of molten zinc are applied to every square foot exposed, equal to a thickness of .0036 inches.

From pickling and pre-fluxing, through the galvanizing, Havens' Tower casings are adequately prepared to combat rust and corrosion.



FEATURES:

- Fan Screen
- Belt Guard
- Weather Protected Motors
- Stainless Steel Fan Shaft
- Sheaves, Corrosion Resistant Cast Iron
- Steel Sheets—Heavy Guage Hot Rolled Mild Steel

33 SERIES
3 TO 75 TONS
"V" SERIES ALSO AVAILABLE
80 THROUGH 600 TONS

Write for Literature

PERFORMANCE PROVED

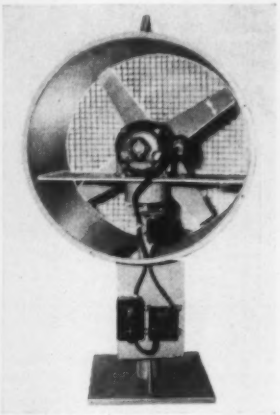
Havens

COOLING TOWERS

Division of
HAVENS STRUCTURAL STEEL COMPANY
1713 CRYSTAL AVE., Kansas City 26, Missouri
MEMBER OF ARI COOLING TOWER SECTION

EQUIPMENT DEVELOPMENTS

Continued



Oscillating Fan . . .

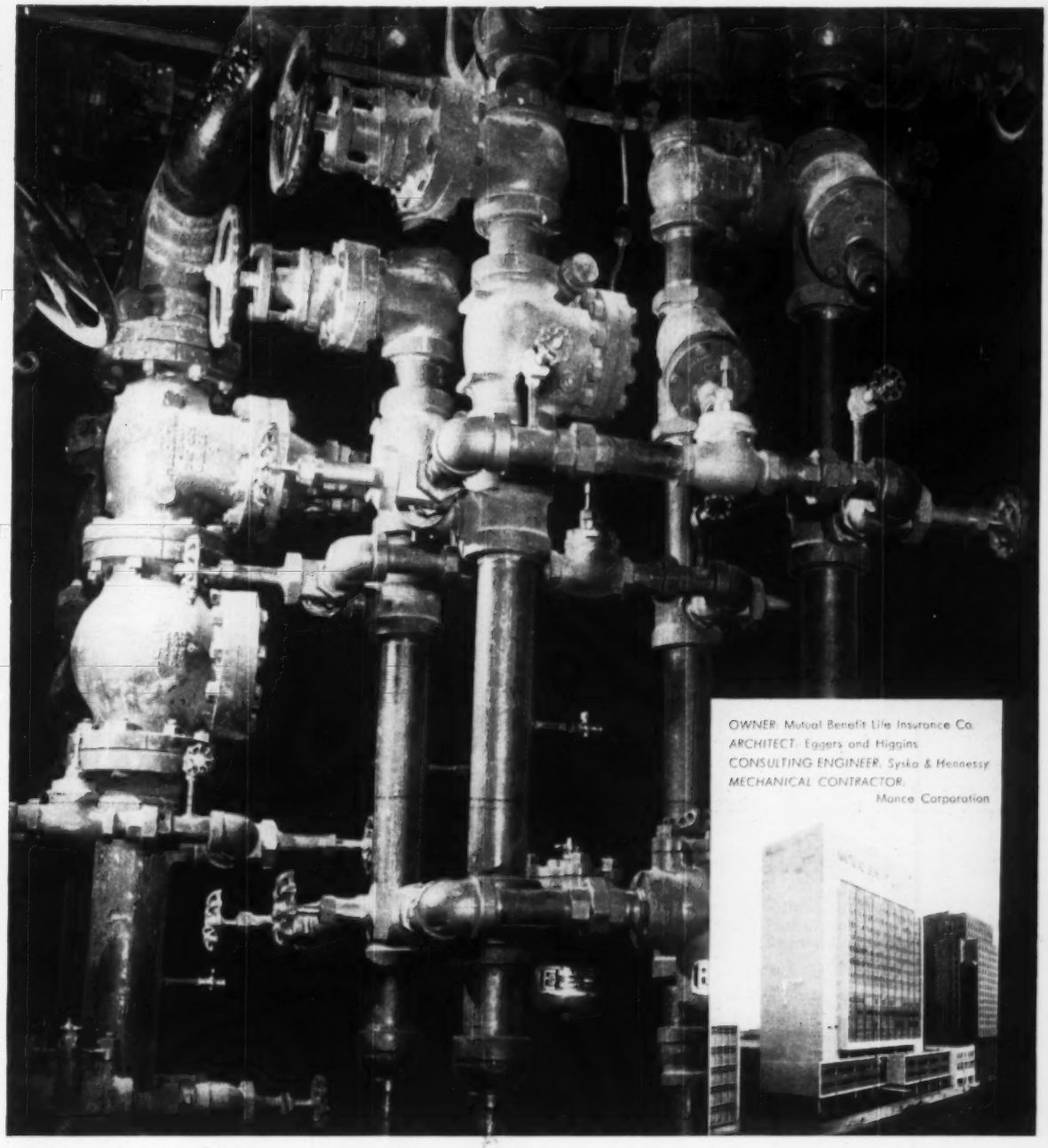
. . . developed for wide application in industrial plants, warehouses—*Maxwell & Moore, Inc., Dept. HP-AC, 155 Henderson St., Zelienople, Pa.*

Fan has gear motor drive with positive oscillating movement. Unit is of steel construction, electrically welded throughout. Totally enclosed in heavy duty wire mesh, available in blade sizes 30 to 42 in., 1½ to 7½ hp.

Dial Thermometer . . .

. . . designed to provide ease in mounting and reading—*Manning, Maxwell & Moore, Inc., Dept., HP-AC, 250 E. Main St., Stratford, Conn.*

"Bi-Metal" dial thermometer is 2 in. diam mounted in 18-8 stainless steel case. Has coil centered, welded in stem to retard effects caused by rubbing against side wall. Surrounding silicone fluid speeds heat transfer, dampens vibration. Standard ranges are from −80/120 F to 200/1000 F and from −50/50 C to 100/500 C. Accuracy said to be within range of 1 percent.



In its new 20-story Home Office Building in Newark, New Jersey,

THE MUTUAL BENEFIT LIFE INSURANCE COMPANY

USES **WALWORTH VALVES...100%**

in both Plumbing and Heating Systems

WALWORTH

750 THIRD AVENUE, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

WALWORTH SUBSIDIARIES: ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO. M&H VALVE & FITTINGS CO. • SOUTHWEST FABRICATING & WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.

7 WAYS YOU GET A BETTER BUY...

with USG Industrial Thermometers

1. You get **top quality.**
Gotham Industrial Thermometers are made by United States Gauge. That means you get the benefits of 54 years experience in the manufacture of precision measuring instruments.

2. You get **high accuracy.**
Bores of the mercury columns in Gotham thermometers are held to uniform dimensions for the length of the glass stem. Each thermometer is calibrated under strictest control standards with permanent reference points etched on the lens.

3. You get **good readability.**
Extra sharp readability is assured by USG's magnifying glass tube with a wide angle reading design, and by use of highly-visible "Red-reading Mercury." Figures and graduations are large, clear and in black on silver background.

4. You get **better response.**
USG design assures better response to temperature changes in all your applications. Safe, efficient heat transfer material fills the space between metal stem and inserted glass bulb. Where separable sockets are used, metal stem and socket are tapered to assure snug, metal-to-metal contact. Result: you get fast readings, exact readings.

5. You get **longer life.**
USG Gotham thermometers are ruggedly constructed to "take it." Glass tubes are annealed to remove residual stresses. Extra-heavy glass fronts on the solid brass case are cushioned with chemical-resistant rubber. Maintenance and replacement costs are lowered.

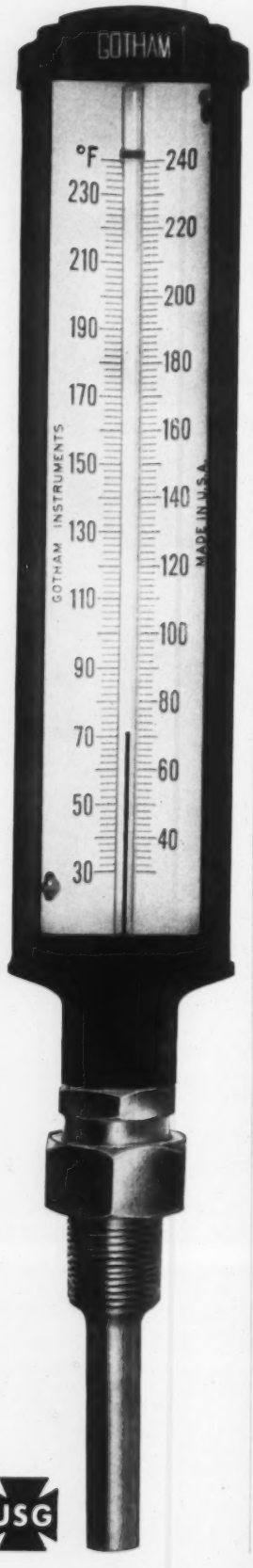
6. You can get **any angle mounting.**
Rigid mounting types include: Straight, Back Angle, Incline, Recline, Right and Left Side. There is also the USG "Multi-Angle" type which saves valuable manhours on piping layouts because it can be tilted or rotated to any practical mounting angle.

7. You save with the **low cost.**
There is a USG industrial thermometer for virtually every temperature measurement in heating and air conditioning. Temperature ranges are from —40° to 950° F. Sizes: 7, 9 and 12 inches.

Most important, the USG low price is an eye-opener when you compare thermometer design, features and performance . . . *critically*. Start your big USG savings now. See your USG distributor, or write for Catalog 101.

Find Your Nearest Distributor in The 'Yellow Pages'

UNITED STATES GAUGE
Division of American Machine & Metals, Inc., Sellersville, Pa.

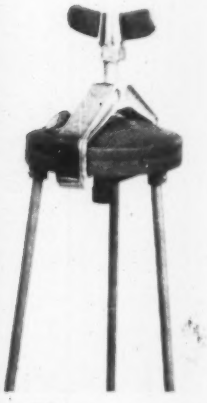


EQUIPMENT DEVELOPMENTS
Continued

Air Handling Unit . . .

. . . for heating, cooling, ventilating applications—*Recold Corp., Dept. HPAC, 7250 S. Slauson Ave., Los Angeles, Calif.*

"AH-24" is horizontal unit 17¾ in. high, 26¾ in. wide and 39 to 67 in. long (length varies with number of coils used). Unit has 2.4 sq ft of nominal coil face area and will handle 1200 cfm. Discharge may be at top, bottom or rear; motor may be mounted top, bottom, rear or either right or left side; coils may have right or left hand connections; filter box may be side, top or bottom; hanging channels may be top or bottom. Reduced face coil of 1.84 sq ft also available.



Pipeline Filter . . .

. . . intended for use in laboratory work, pharmaceutical manufacturing, other applications where pure water supply is necessary—*Barnstead Still & Sterilizer Co., Dept. HP AC, Lanesville Terrace, Boston 31.*

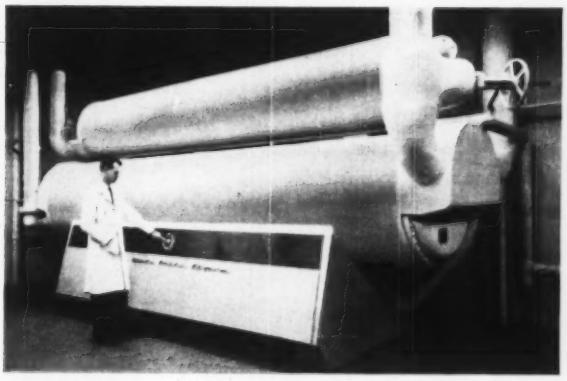
Unit is for use with distilled or demineralized water, removes particulate matter down to 0.45 micron. Filter media is cellulose ester membrane. Standard units constructed of bronze lined with pure block tin on interior surfaces; also supplied with plastic interior coating for special applications. Inner surfaces may be nickel coated or entire unit may be made of stainless steel or aluminum. Total height is 20 in. Rate of flow is 25 to 100 gph.

BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

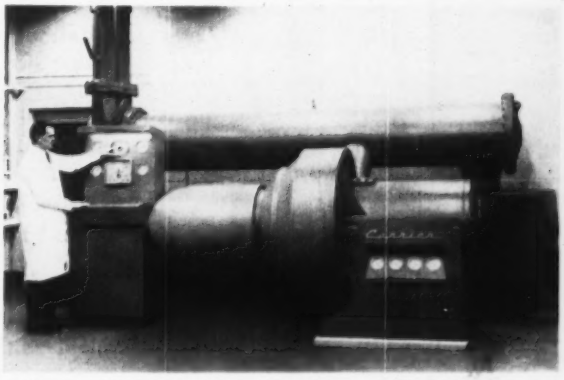
Carrier

Which is the best way to air condition a factory?

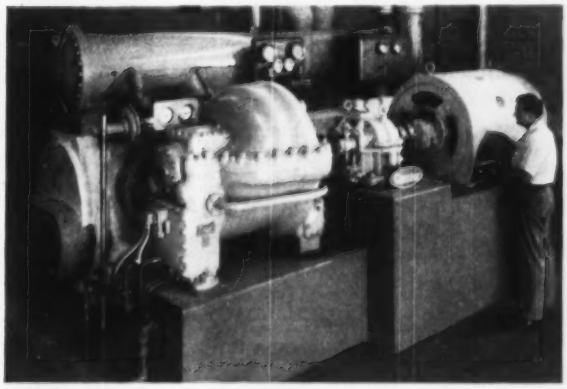
It depends on the factory. Its size, its shape and its construction are all important. The available power facilities are important, too, in determining which refrigerating machine is best. Carrier sells many types of air conditioning and refrigeration. For example, four types of refrigeration are shown below. Only Carrier makes all types. Each provides unique advantages under special conditions. Which is best for your requirements? For complete information, call your nearest Carrier office. Or drop a line to us at Carrier Corporation, Syracuse, New York.



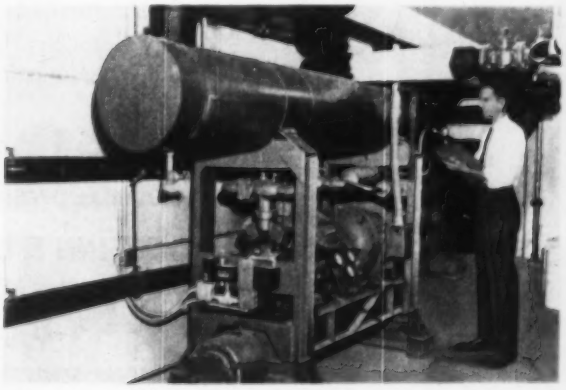
If you have low-cost steam, Carrier's new Absorption Refrigeration Machines may be best. They use heat energy from low-pressure steam or hot water to produce cooling. They're dependable, efficient. Operation is automatic, quiet and vibration-free. Cooling capacities: 60 to 700 tons.



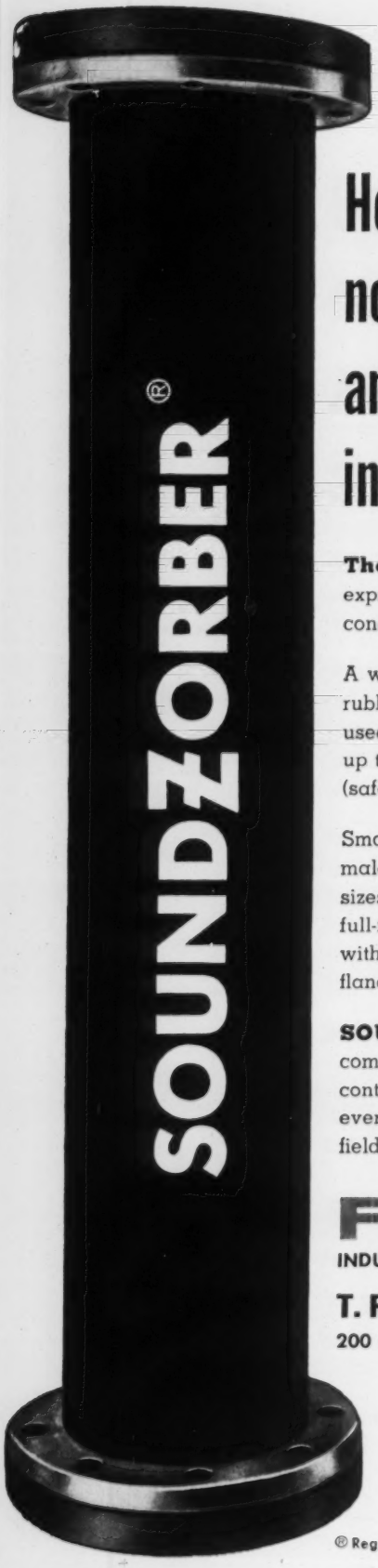
If you have low-cost power, new Hermetic Centrifugal Refrigeration may be the answer. Compactness and light weight minimize space and structural requirements. Electronic controls provide continuous, automatic chilling of water to the desired temperature. From 90 to 1100 tons.



If the factory is large, Carrier's famous external drive Centrifugal Refrigerating Machines may be best. With capacities to 4000 tons, they can serve the largest air conditioning system automatically and economically. Thousands are in use today in buildings all over the world.



If the factory is small, Carrier Reciprocating Water Cooling Machines may be ideal. They're completely "packaged." Installation costs are lower and operation more efficient than units assembled from unrelated components. Their cooling capacities range from 3 to 200 tons.



How to stop noise, vibration and "hammer" in water lines

The original SoundZorber expressly designed for use in air conditioning water lines . . .

A wire-reinforced wrapped fabric rubber pipe, SOUNDZORBER can be used continuously in water lines at up to 250 psi working pressure (safety factor: 5 to 1).

Smaller sizes ½" to 3" available with male I.P.T. bronze fittings. Larger sizes available with integral full-faced rubber flanges backed up with Series 15 or Series 30 steel flanges. No metal-to-metal contact.

SOUNDZORBER is but one of a complete line of Finn vibration controls. Finn has control devices for every vibration problem in your field. Write for complete information.

FINN
INDUSTRIAL DIVISION
VIBRATION FINNFLEX CONTROL

T. R. FINN & Company, Inc.
200 Central Ave., Hawthorne, N. J.

REPRESENTATIVES wanted. If interested write or call, describing qualifications.

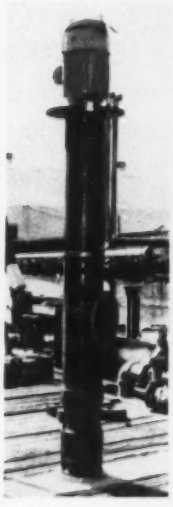
® Reg. U. S. Patent Off.

EQUIPMENT DEVELOPMENTS
Continued

Water Heater . . .

. . . for small commercial applications requiring high recovery during certain periods of day—*Republic-Odin Appliance Corp., Dept. HPAC, 1901 S. Boyle Ave., Los Angeles 58.*

The "10SD Extra Hi-Recovery Booster" has dual controls, four burners, permitting recovery of 112 gph at 60 F temperature rise. Unit measures 68⅞ in. high; exterior dimensions are 20 × 55½ in.



Vertical Pump . . .

. . . designed to pump heat-transfer fluids at temperatures around 500 F —*Berkeley Pump Co., Dept. HPAC, P. O. Box 7, Station A, Berkeley, Calif.*

To isolate explosionproof motor from hot pumping element, fans used to cool pump shafting and water jacket to cool column section separating pump and motor. Unit shown pumps 1200 gpm at 30 ft head. Inverted arrangement lowers seal pressures, increases net positive suction head.

Liquid Level Controls . . .

. . . developed for the measurement control of liquid level in tanks or level of solids in bins and silos *Industrial Nucleonics Corp., Dept. HPAC, 1205 Chesapeake Ave., Columbus 12, Ohio.*

Features cited include: external

ROBVON

BACKING RINGS

APPROVED FOR WELDED PIPE, VALVES, AND FITTING JOINTS

- ✓ Nub diameter automatically sets welding for root pass
- ✓ Forms perfect welded joint eliminating slag and icicles
- ✓ Allows complete penetration and fusion
- ✓ Eliminates the necessity of tack welding
- ✓ Radiographs a perfect certified weld

Available in Carbon Steel, Wrought Iron, Chrome Alloys, Stainless Steel, Aluminum and Copper

TYPE CCC Designed for quick easy alignment of pipe where the variation in inside diameters is relatively great. Chamfered NUBS allow close tolerance fit-up and CLEAN STRIKE OFF. The ROBVON NUB conforms to the diameter of weld rod. Robvon rings are beveled to assure non-restricted fluid flow.

TYPE CC Designed to allow quick easy alignment of pipe where the inside diameters are slightly out of round. The welder has the choice of "STRIKING OFF" the NUBS or leaving them intact to be melted into the weld mass of the first root pass.

TYPE C Designed for precise tolerance fit-up. Type "C" NUBS conform to the diameter of the weld root. The NUBS melt with the metal to give complete penetration and fusion.

WRITE FOR FULL INFORMATION

ROBVON ALSO MANUFACTURES MACHINED RINGS TO CUSTOMER'S SPECIFICATIONS. ALL FABRICATED SOLID MACHINED RINGS X-RAYED.

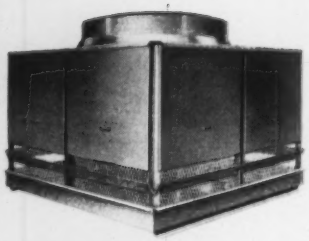
ROBVON
BACKING RING COMPANY

675 Garden Street **Elizabeth, N. J.**

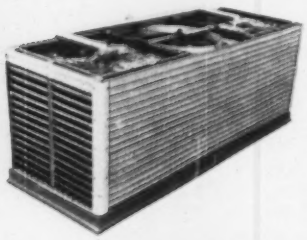
IMPORTANT NEWS FOR COOLING TOWER BUYERS

Dover "Packaged" Cooling Towers Join Famous Pritchard Line

J. F. Pritchard & Co. of California and Dover Manufacturing Company merged October 1 to offer one of the most complete range of cooling tower sizes and types in the industry. Dover's line of "packaged" towers plus Pritchard's field-assembled towers can answer the requirements of any water cooling job. Write for catalog details.



SILLOWETTE



LOLINE

INDUSTRY'S PARTNER FOR PROGRESS

COOLING TOWERS
GAS & AIR TREATING EQUIPMENT

REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

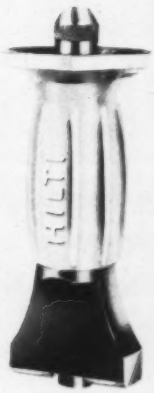
J.F. Pritchard & Co.
OF CALIFORNIA

4625 Roanoke Parkway, Kansas City 12, Mo

EQUIPMENT DEVELOPMENTS

Continued

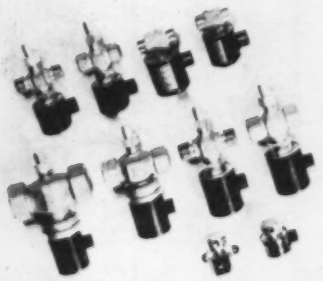
application—no entry through vessel walls; no contact with process materials; no vacuum tubes—transistors used instead.



Fastening Tool . . .

. . . said to require no drilling, explosives, electricity or compressed air—*Hilti Rapid Fastening Systems, Inc., Dept. HPAC, Stamford, Conn.*

"T-25H Drive Tool" is one piece chrome nickel steel drop-forging with special alloy drive ram and moulded hand grip. Fasteners are rustproof, available in drive pins, threaded studs and drive-ring fasteners in lengths to 4 in.



Solenoid Valves . . .

. . . designed for use in many applications—*Controls Co. of America, Dept. HPAC, 2450 N. 32nd St., Milwaukee.*

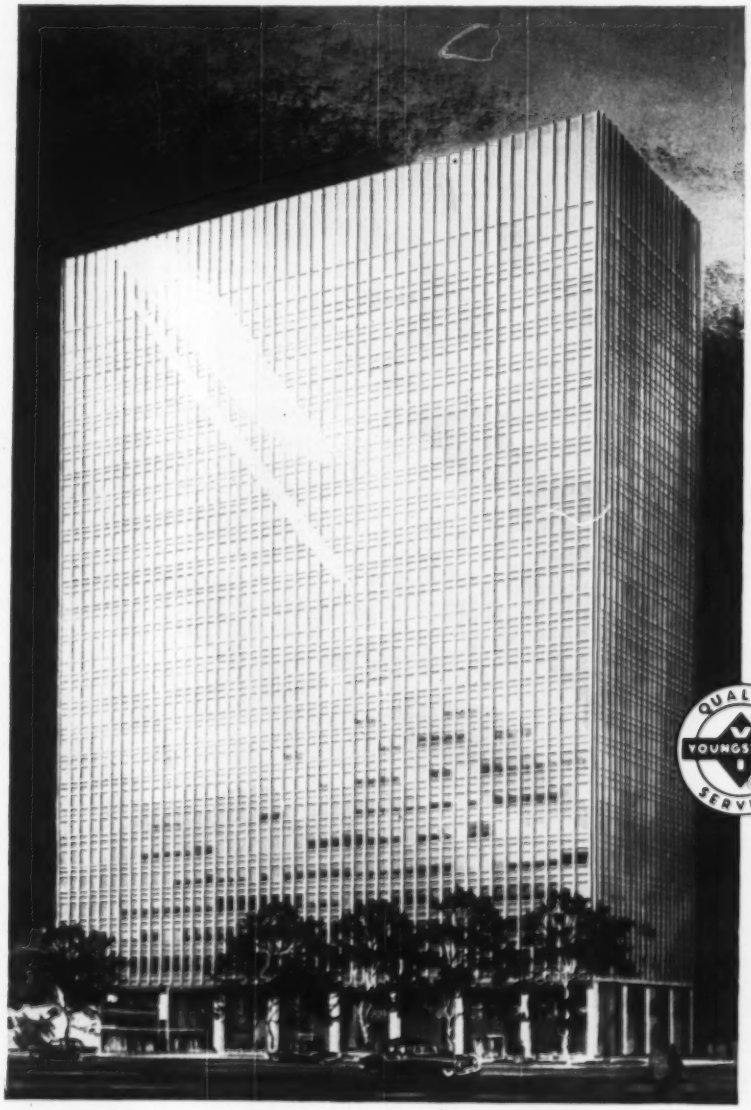
"291" solenoid valves available in brass or stainless steel and in 6 orifice sizes. Can be used for air, gas, water, oil, common industrial fluids. Types

Cleveland's "Modern as Tomorrow"

ILLUMINATING BUILDING

uses Youngstown Steel Pipe

Building Owner: 55 Public Square, Inc., New York, N Y
(A Vincent Astor-Brooks, Harvey & Company enterprise)
Rental and Managing Agents Ostendorf-Morris Company, Cleveland, Ohio
Architect. Carson & Lundin, New York, N Y
General Contractor George A Fuller Company, New York, N. Y
Structural & Mechanical Engineers: McGeorge Hargett & Associates
Consulting Mechanical Engineers Jaros, Baum & Bolles
Heating & Air Conditioning Contractor: The Feldman Bros. Company, Cleveland, Ohio
Distributor Grinnell Company, Cleveland



Cleveland's newest architectural beauty — this modernistic 22-story Illuminating Building — will provide much-needed air-conditioned office space for the "Best Location in the Nation". Owner of the new structure, 55 Public Square, Inc., and the architects, wisely chose Youngstown Steel Pipe to provide for a long-lived, dependable water supply system.

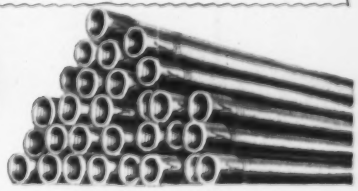
Youngstown Steel Pipe is the best pipe obtainable—anywhere. That's because it's made from our highest quality steel by men who have devoted their lives to the pipemaking business. Each and every step in Youngstown's completely integrated operations is closely quality-controlled by expert metallurgists to guarantee pipe that will meet your most exacting specifications.

Your nearby Youngstown Pipe Distributor has complete and ample stocks in all sizes. Why not call him today and discuss your requirements?

Specify Youngstown and secure these
7 Points of uniform goodness

- uniform ductility
- uniform lengths
- uniform threading
- uniform weldability
- uniform wall thickness and size
- uniform strength and toughness
- uniform roundness and straightness

QUALITY YOUNGSTOWN SERVICE



THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of
Carbon, Alloy and Yoloy Steel

General Offices - Youngstown 1, Ohio
District Sales Offices in Principal Cities

You're Paying for W-S Quality . . .

BE SURE YOU GET IT!

W-S Forged Steel Fittings fit the pattern of all top quality products. The best costs no more in the long run. In terms of trouble and inconvenience, second-best will always be expensive. These are the reasons why you are money ahead to insist on C-1025 W-S Fittings.

- Low carbon C-1025 steel insures optimum weldability.
- Special bar quality steel for density, strength, and consistent composition. Install 'em and forget 'em.
- Steel physicals excel ASTM specs for forged steel fittings.
- Heat coded to insure identification.
- Made in our own Forge Shop.
- Full control of quality to produce "Best in Industry!"

For information about 1025 steel and for your commercial forging requirements, write to Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, New Jersey.

ROUGH FORGING BEFORE TRIMMING

ROUGH FORGING AFTER TRIMMING

FINISHED FITTING

H. K. PORTER COMPANY, INC.

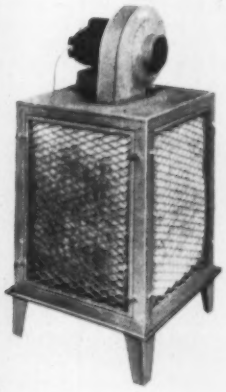
FORGE AND FITTINGS DIVISION

W-S Fittings Works, Roselle, N. J. • Cleveland Forge Works, Cleveland 4, Ohio
Stainless Steel Works, Duncannon, Pa.

EQUIPMENT DEVELOPMENTS

Continued

"271," through "274" solenoid valves designed for main liquid line valve control on multiple cooling systems and as bypass valve to prevent motor overload during starting periods. Available in four models with four orifice sizes, several sweat and pipe connections. Bodies of bronze. Types "67" and "73" have brass bodies with frost resistant coil construction.



Mist Collector . . .

. . . engineered to control mists from wet machining operations—*Torit Mfg. Co., Dept. HPAC, 292 Walnut St., St. Paul 2, Minn.*

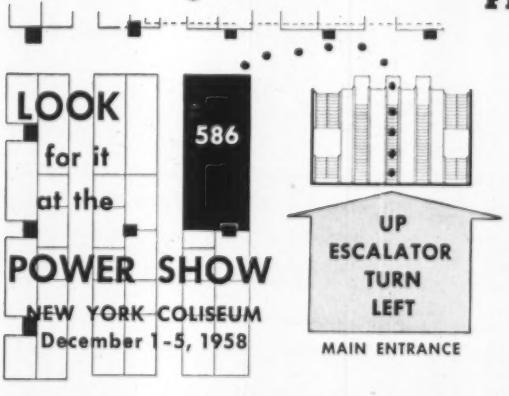
Unit measures 22 in. around, 47 in. high, can be mounted on floor, walls or ceiling. Filters mist, fog by passing air through spun glass filters. Condensed coolant mist collected in bottom of collector to be drained for re-use. Performance ratings: 632 cfm; velocity, 4650; external static pressure, 2.15 WG with 5 in. diam inlet. Equipped with ½ hp motor, available in 110 volt/60 cycle or 220-110 volt/60 cycle. Fan speed is 3450 rpm, filter area, 12 sq ft.

Water Insulation . . .

. . . developed for block and cavity wall construction—*Zonolite Co., Dept. HPAC, 135 S. LaSalle St., Chicago 3.*

Insulation is free-flowing mineral, water-repellent vermiculite and can be poured from bag into block cores. Block wall can be erected, insulated without bridging, says manufacturer.

HERE'S YOUR *Complete* STEAM PLANT



FEATURES of the **SUPERIOR** "COMPACT"

- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides 5 sq. ft. of heating surface per b.h.p.
- Induced draft fans which are built-in eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Heavy-duty, rugged construction assures long-lived dependability.
- Burner equipment to suit your fuel: gas, oil or both.
- Capacities from 20 to 300 b.h.p. for pressures up to 250 p.s.i., or for hot water heating. Write today for bulletin 1004C

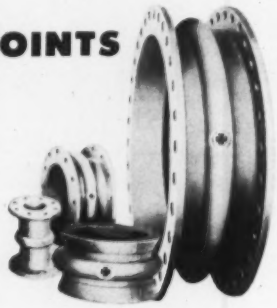
Specialists in **PACKAGED BOILERS** ... exclusively

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR PACKAGED BOILERS

YOU CAN *Profit* BY THE USE OF THESE *Practical* PRODUCTS OF GOODALL ENGINEERING . . .

Rubber EXPANSION JOINTS



Custom-built to meet specific requirements in sizes from ⅜" I.D. to 96" I.D., for pressures up to 125 lbs. P.S.I. and/or vacuum. Available in Right Angle Sleeve Types and "Flang-Lok"; single or multiple arch; tapered; offset; and rectangular.

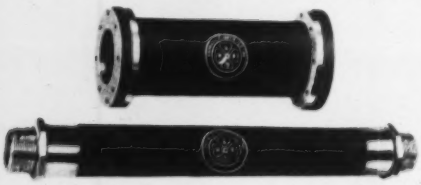
LONGER SERVICE LIFE. No deterioration through embrittlement or corrosion.

SENSITIVE RESPONSE TO PRESSURE. Only slightest pressure required to create movement in the joint, in any direction. Stress on metal pipe or other connected member reduced to absolute minimum.

EASIER TO INSTALL. Light in weight . . . short face-to-face dimensions . . . retaining rings or flanges quickly aligned and bolted. No gaskets required.

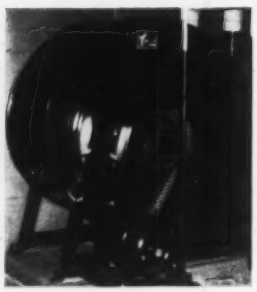
Rubber VIBRATION —SOUND ABSORBER UNITS

Economical for use in many installations in place of expansion joints, for effective control of vibration and noise emanating from water pipes, air conditioning, heating and ventilating equipment. Strong, durable, resilient rubber compound, with wear and weather-resistant cover. Plain or with built-in wire reinforcement. Furnished with I.P.T. ferrules or steel split connecting flanges. Sizes ½" to 12" I.D., in lengths from 12" to 48".



"Rubberhide" LININGS FOR CORROSION CONTROL

"RUBBERHIDE" Linings are compounded to assure long-lasting protection against the particular corrosive agents involved. They will repay many times their cost through extended life of products, parts or equipment. Produced with either rubber or neoprene as the base material. Processed to objects shipped to our Linings Plants in Trenton, Chicago or Houston; or, when the objects are too large for such shipment, or the work involves fixed plant equipment, experienced field crews do the processing "on location".



"If it's GOODALL, it MUST be Good!"

Contact Our Nearest Branch or Write for Catalog

Standard of Quality—Since 1870

HOSE · BELTING · FOOTWEAR · CLOTHING AND OTHER INDUSTRIAL RUBBER PRODUCTS

GOODALL *Rubber Company*

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

BRANCHES AND DISTRIBUTORS THROUGHOUT THE UNITED STATES. IN CANADA: GOODALL RUBBER CO. OF CANADA LTD., TORONTO.

EQUIPMENT DEVELOPMENTS

Continued

Vacuum Cleaner . . .

. . . with new, redesigned motor head —*Pullman Vacuum Cleaner Corp., Dept. HPAC, 25 Buick St., Boston* 15.

"Model JB 252 F" uses self-cooling bypass a-c, d-c 1¼ hp motor with increased suction due to larger exhaust area. Available for 64, 115, 150 or 230 volts, cycles zero through 60. Height: 31 in.; diam: 16 in.; water-lift: 75 in. water gage maximum. Capacity container 17 gal, recoverable 1¾ bushels or 12 gal. Available for wet or dry pickup.

Equipment Briefs . . .

PAPER TAPES with rubber resin white adhesive mass —*Permacel, Dept. HPAC, New Brunswick, N. J.* "EM3979" flatback tape and "EM 4082" flexible flatback tape have high and cold temperature resistance qualities. Both are odor free, stain resistant, can be used with automatic dispensing machinery.

THREAD LUBRICANT intended to prevent galling of threaded parts —*Parker Fittings & Hose Div., Parker-Hannifin Corp., Dept. HPAC,* 17325 *Euclid Ave., Cleveland* 12. Recommended by company for reducing wrench torque in makeup of bite type tube fittings. "Ferulube" said to reduce makeup torque up to 75 percent.

Kathabar® systems kill micro-organisms and hold rooms at specific low bacteria and mold levels!

Because bacteria are killed by the chemical absorbent in a Kathabar system, it was long suspected that air passed through this system should be relatively free of bacteria. Proof of this theory would be of vital importance wherever airborne organisms contaminate humans or products.

To check this hunch, Surface asked a university research staff to conduct a series of exhaustive tests.

research proof

The conclusion of the research staff is that 97% of all micro-organisms (both pathogenic and non-pathogenic) are removed from air which passes through a standard Kathabar unit.

More tests are being continued in several industries with varying conditions. Current research results indicate that air purification—long desired by many industries and institutions—can be as feasible and simple as purification of drinking water.

what does it mean?

The system's advantages for hospitals show the significance of these findings. It provides the first continuous source of pure air. A Kathabar system will deliver to operating rooms air with not to exceed 5 organisms per 10 cubic feet (measured by the All-Glass Impinger method); provided the air supply contains 100 or less organisms per 10 cubic feet. This will maintain an operating room, with normal occupancy, at 10 organisms or less per 10 cubic feet—1/10 the normal level found by actual readings in hospitals.

The liquid sorbent is not affected by the organisms it kills. It is equally effective with any volume of air you require for your space or process.

The system also provides practical, year-round humidity control. It will humidify in the winter; dehumidify in the summer.

When possible it permits recirculation of air for operating, delivery, cystoscopic, and fracture rooms. Eliminating the need for all fresh air reduces both the first cost and operating cost of a Kathabar air conditioning system.

benefits for other industries

Hospitals, of course, are not alone in their need for continuous pure air. Direct and immediate benefits can be realized in other fields, too, such as foods, pharmaceuticals, beverages, clinics, laboratories, and public buildings.

Even where pure air is not a primary factor, it is an important added benefit. Examples are drying operations, storage, testing, comfort applications.

who uses Kathabar systems

Kathabar systems make profits out of air for these industries:

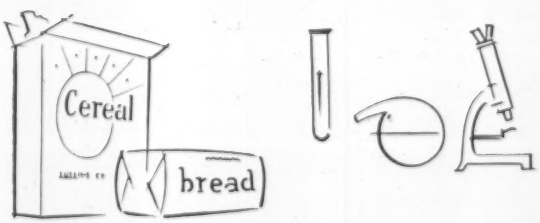
Atomic Energy	Machining
Breweries	Matches
Cake Mix	Marine
Candy	Meat
Cellophane	Offices
Cellulose	Ordnance
Cereals	Paper
Chemicals	Pharmaceuticals
Coffee	Plastics
Comfort	Printing
Compressors	Rockets
Cookies	Rubber
Electronics	Shellac
Explosives	Sugar
Film	Sanitaryware
Foundries	Testing
Gelatin	Textiles
Glass	Transformers
Glue	Transistors
Gum	Vacuum Tubes
Hospitals	Varnish
Hotels	Waterworks
Lacquer	Wire
Lenses	Yeast

how they use Kathabar systems

Many of these industries are now discovering the benefits of air sterilization by Kathabar systems. Others use them to (1) maintain spaces at 80 F and 55% RH or lower; (2) obtain continuous air at sub-freezing dry bulbs and dew points; (3) eliminate condensation; and (4) improve drying processes.

send description of your problem

Air Conditioning and Drying Division
SURFACE COMBUSTION CORPORATION
2385 Dorr Street Toledo 1, Ohio



Kathabar systems by Surface®

Ramset® saves contractor $24.00 a day per man!

RAMSET saved this contractor 80% in man-hours. That's $24 a day per man!

How? Powder-actuated RAMSET took all the fuss out of fastening ducts to the framework of this building. The job was finished fast, easy and sure.

Power and fasteners were carried conveniently in the operator's pocket . . . no time wasted dragging bulky equipment or power lines. Less danger of tripping also.

The lightweight tool was handled with ease on beam, scaffold and ladder . . . the hard-to-get-at places "opened up."

100 for 100 Guarantee, a RAMSET exclusive that *fixes* your fastener costs . . . you pay only for the fasteners called for on the blueprint. If a RAMSET fastener goes haywire for any reason, RAMSET replaces it quickly . . . free!

Whatever your fastener needs, RAMSET delivery is immediate, "right to the job" . . . just call your RAMSET dealer. He's listed under "Tools" in the Yellow Pages.

And, when you call him about RAMSET, ask also about the SHURE-SET® hammer-in fastening tool . . . RAMSET's companion for the light-duty fastening jobs in concrete and building block.

Be sure to write today for both the RAMSET and SHURE-SET catalogs.

OLIN MATHIESON CHEMICAL CORPORATION — Ramset — *Ramset Fastening System*

WINCHESTER-WESTERN DIVISION

OLIN MATHIESON CHEMICAL CORPORATION

12109-K Berea Road • Cleveland 11, Ohio

EQUIPMENT DEVELOPMENTS

Continued

MARKING CRAYONS with patented soap base that washes off without use of solvents—*Crayoff Corp., Dept. HPAC, 34 Roberts St., Pasadena 3, Calif.* Markings made with "Crayoff" can be wiped off smooth surfaces with dry cloth, washable surfaces with damp cloth. Crayon is 4 in. long, ½ in. diam, can be used on wood, glass, metals, plastics, rubber, ceramics, linoleum, cellophane, etc.

PAPER THERMOMETERS available for 100, 105, 110 F—*Paper Thermometer Co., Dept. HPAC, 10 Stagg Dr., Natick, Mass.* Indicators measure temperature by exhibiting irreversible color change when subjected to predetermined temperatures. Speed of response is less than 1/10 sec; accuracy within 1 percent.

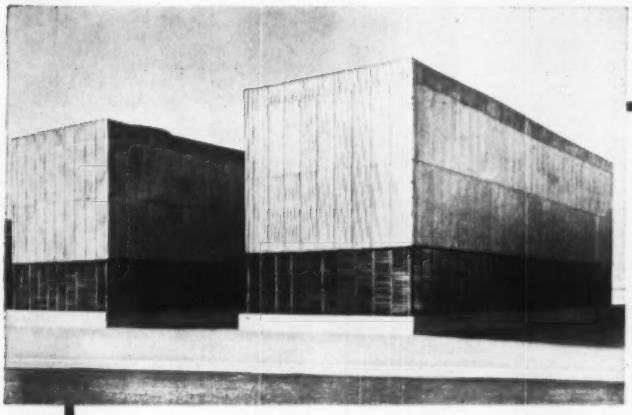
ARC WELDERS in 250 amp d-c, 300 amp phase a-c/d-c "Heliwelder" —*Air Reduction Sales Co., Dept. HPAC, 150 E. 42nd St., New York 17.* All machines provide 115/230 volt, 10 kw single phase 60 cycle power when operated as power plants. Have 115 volt, 1 kw d-c auxiliary power available for operating lights, power tools while welding.

TEMPERATURE MONITOR developed to monitor up to 24 stations in sequence—*Assembly Products, Inc., Dept. HPAC, Chesterland 1, Ohio.* Selector switch, immersed in oil, checks stations in order, 12 per min. Signals from thermocouples or other sources indicated continuously by moving pointer of meter-relay. Alarm sounded if pointer touches high or low limit.

VACUUM GAGE—developed for direct reading, recording, control of absolute pressures in range 0.1 to 20 mm of mercury—*Hastings-Raydist, Inc., Dept. HPAC, Hampton, Va.* Vacuum gage has noble metal thermopile designed to measure vacuum,

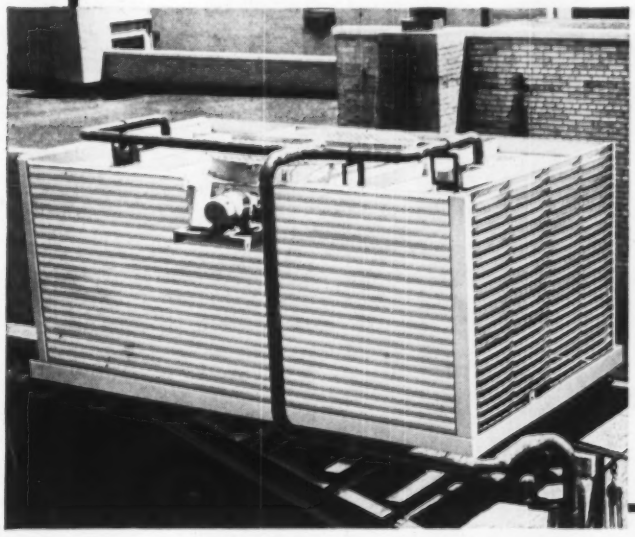
HEADQUARTERS FOR COOLING TOWERS

150 TONS and UP



Tower on left is redwood framed Type WT with cement asbestos casing and louvers. Type WT towers are available from 500 tons and up.

Counterflow Type Towers available with either redwood or steel framing. Steel framing members are all hot dipped galvanized after fabrication in accordance with ASTM specifications. Partitions, louvers and siding of cement asbestos board are standard on this type of tower.



Series "DA" towers are available in California redwood, or Hot Dipped Galvanized framing. Corrugated cement asbestos board casing, laid horizontally, is fastened to frame with Galvanized bolts and Neoprene washers. Slipfit louvers of flat cement asbestos board provide easy access. All hardware is Hot Dipped Galvanized.

SPECIAL FEATURES ON ALL TOWERS

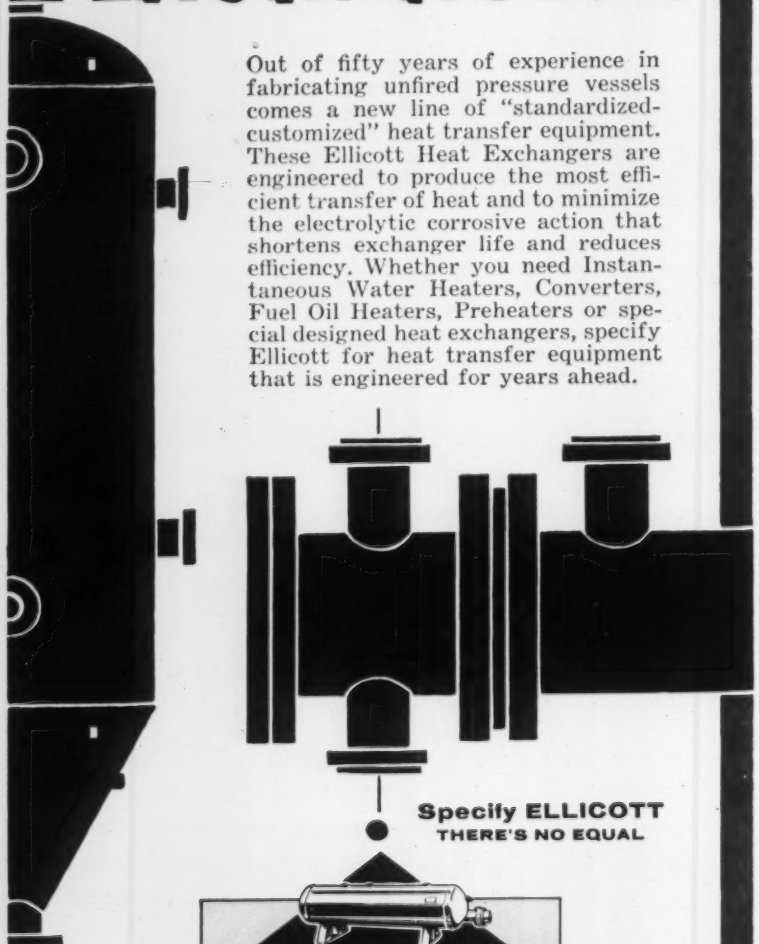
Corrosion Resistant Hardware. Aluminum or Stainless Steel Fans. Nailless Redwood Filling Removable at Tower Base. Nailless Three-Pass Redwood Eliminators. Removable Louvers.

Phillips Cooling Tower Co., Inc.
220 DUPONT ST., BROOKLYN 22, N. Y.

Engineered
for years ahead

HEAT
EXCHANGERS

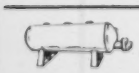
Out of fifty years of experience in fabricating unfired pressure vessels comes a new line of "standardized-customized" heat transfer equipment. These Ellicott Heat Exchangers are engineered to produce the most efficient transfer of heat and to minimize the electrolytic corrosive action that shortens exchanger life and reduces efficiency. Whether you need Instantaneous Water Heaters, Converters, Fuel Oil Heaters, Preheaters or special designed heat exchangers, specify Ellicott for heat transfer equipment that is engineered for years ahead.



Specify ELLICOTT
THERE'S NO EQUAL

ELLICOTT
FABRICATORS, INC.
SUBSIDIARY OF
ELLICOTT MACHINE CORPORATION

formerly NOVELTY STEAM BOILER WORKS, INC.


HOT WATER GENERATORS

STORAGE TANKS

SPECIAL LININGS

SPECIAL FABRICATION

Representatives in Major Cities

Clare and Kloman Streets • Baltimore 30, Maryland

EQUIPMENT DEVELOPMENTS

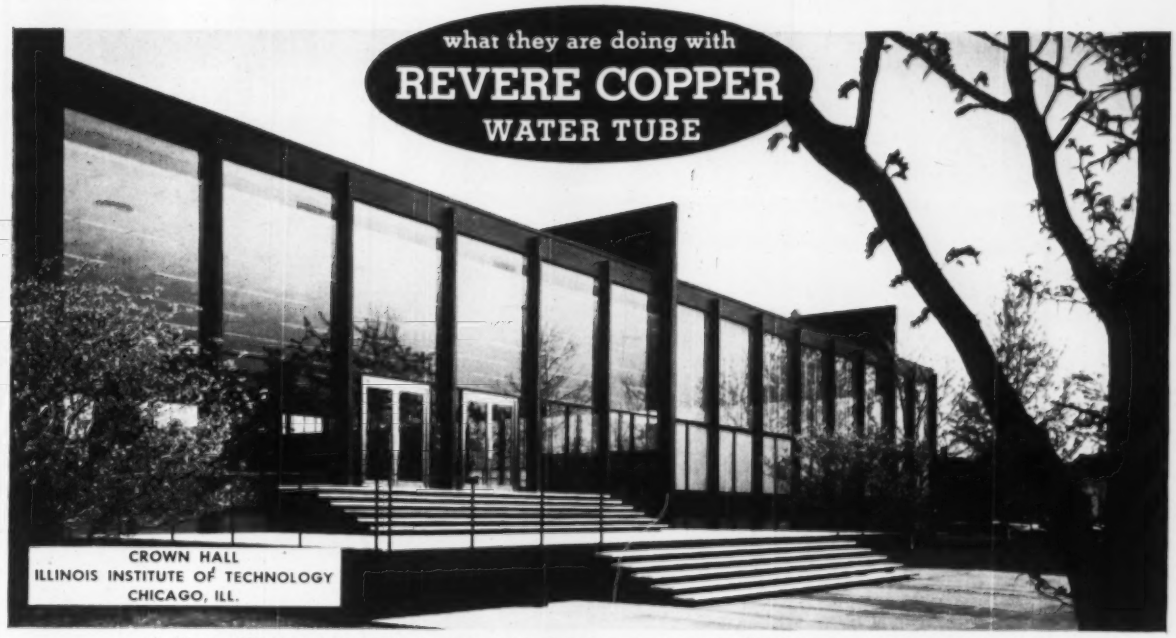
Continued

absolute pressures with accuracy. Gages have characteristic of responding to total pressure of all vapors as well as permanent gases in vacuum system.

FASTENER HOLDERS in types designed for special applications—*Olin Mathieson Chemical Corp., Dept. HPAC, 460 Park Ave., New York* 22. One of new holders designed to seat threaded studs in concrete when installing protector mountings, terminal strips for telephone installation and tubing clips for temperature control. Another has bevelled sides permitting fastener holder to fit between loops of double tubing clip as used on temperature control installations. Third fastener designed for hard-to-reach places. Holder extends 3 in. beyond base of tool housing for installing covers on radiant heating units.

WHITEPRINTING MACHINE—designed to print and develop at speeds up to 20 fpm—*C. F. Pease Co., Dept. HPAC, 3901 N. Rockwell St., Chicago* 18. "Scout" full-width, dry process white-printer said to reproduce in cut sheets or rolls anything typed, written, drawn or photographed on reasonably translucent material. Unit equipped with 2000 watt printing lamp, ribbed rubber sealing sleeve, perforated plastic slip-screen, adjustable print tray.

DRIVE DRILL developed to combine features of positive drive screwdriver and 3/8 in. drill in same unit—*Millers Falls Co., Dept. HPAC, 57 Wells St., Greenfield, Mass.* Special geared key drill chuck with 1/4 in. hex shank inserted in tool's regular chuck for drilling applications. Available in two models: "No. 2660" with saw grip; "No. 2860" with pistol grip. Unit driven at 275 rpm speed by 2 amp motor. Can be used for wood screws, No. 14-3; for machine screws, 1/4 in. and as a drill, 3/8 in. in steel. ≠



Architect: MIES VAN DER ROHE. *Associate Architect-Engineer:* PACE ASSOCIATES. *Structural Engineer:* FRANK J. KORNACKER. *General Contractor:* DAHL-STEDMAN COMPANY. *Landscape Architect:* ALFRED CALDWELL, all of Chicago.

UNIQUE SPLIT SYSTEM meets air change requirements and at the same time gives occupants the many benefits of RADIANT PANEL HEATING

In this split system, ventilation ducts in the ceiling provide the necessary air changes per hour as required by the Chicago Building Code. In the winter the air is heated, supplemented by the radiant panel system in the floor. The warm air system carries the principal heat loss while the radiant panel system offsets the heat loss of the large glass areas.

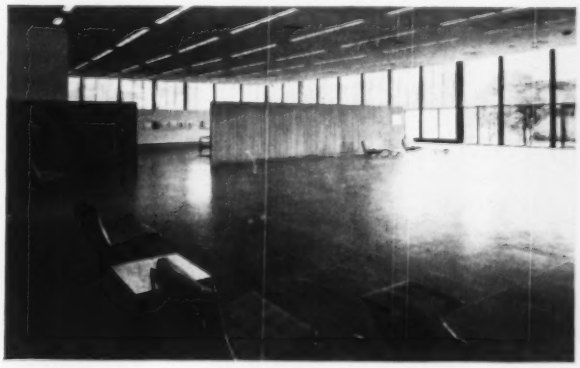
Revere Copper Water Tube was used for radiant heating panels because the standard 60′ lengths mean fewer fittings, the sure soldering of copper means tight joints and its non-rusting qualities mean no clogging or reduction of flow. In addition, contractors are finding out that when properly applied, copper water tube not only is dependable and easier to work, but actually *costs less* than rustable materials.

The inherent qualities of Revere Copper Water Tube also make it the first choice for hot and cold water lines, underground service lines, processing lines, drainage and waste lines, vent stacks. See your Revere distributor for your needs.

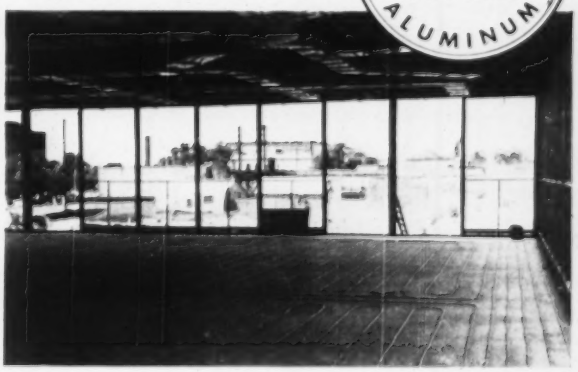
REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.
Mills: Rome, N. Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales offices in Principal Cities, Distributors Everywhere.

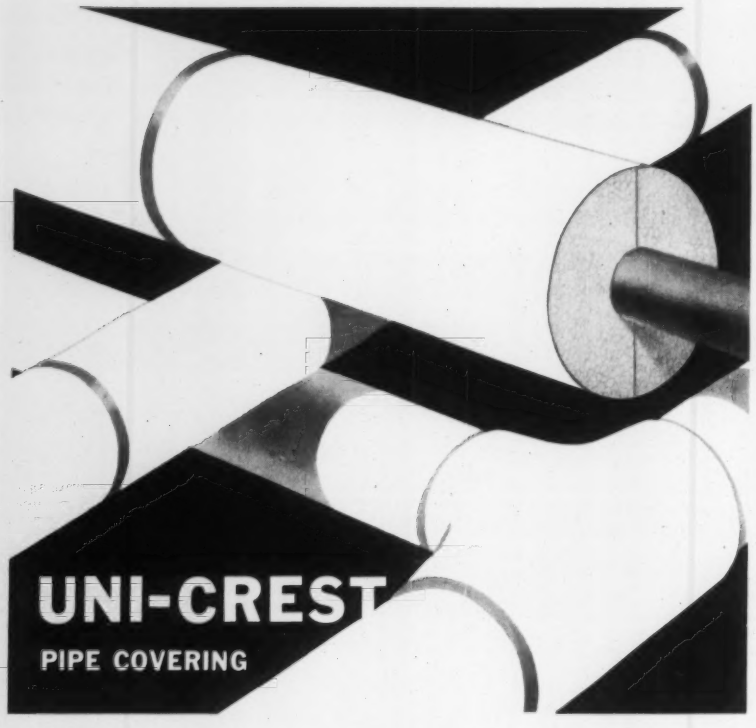
COPPER * BRASS * REVERE * ALUMINUM 1801



13,580 FEET OF TYPE "L" Revere Copper Water Tube were supplied the Heating Contractor, CHICAGO CONDITIONAIRE COMPANY by the Revere Distributor, COLUMBIA PIPE & SUPPLY CO., both of Chicago.



AN IDEAL HEATING COMBINATION—Air ducts in the ceiling and radiant panel heating coils in the floor. Note that, due to greater heat loss, panels near the windows are spaced on 12" centers, while the remainder are on 24" centers.



a new, economical, low temperature insulation

Uni-Crest, pipe covering, is an excellent low temperature insulating material, and is inexpensive to install and maintain.

Uni-Crest's low thermal conductivity (K factor), plus its high resistance to water and water vapor—are some of its prime qualities. It will not rot, mildew, or support fungus growth.

Extremely lightweight, with a smooth, tough white surface, Uni-Crest is non-dusting, non-flaking, and easily cut and handled on the job. And Uni-Crest is inexpensive, too.

For the address of the office nearest you, plus additional information about Uni-Crest pipe covering and an actual sample, please write to the address below.

UNI-CREST DIVISION UNITED CORK COMPANIES
Since 1907

UNITED'S UNI-CREST EXPANDED POLYSTYRENE

1 Central Avenue, Kearny, New Jersey

BRANCH OFFICES OR APPROVED DISTRIBUTORS IN ALL KEY CITIES

RECENT TRADE LITERATURE . . .

▸ *ACTIVATED CHARCOAL*—Pocket-size, illustrated 8 page pamphlet tells of manufacturing processes involved in production of activated charcoal as developed for liquid and gas purification applications. *Barnebey-Cheney Co., Dept. HPAC, Cassady at Eighth, Columbus* 19.

▸ *ADHESIVES*—New, illustrated 4 page catalog gives information on adhesives for bonding insulation and insulating sealers for heating, ventilating, building industries. Four typical applications described; properties, methods, coverage of insulation adhesives presented. *Minnesota Mining and Mfg. Co., Dept. HPAC, 423 Piquette Ave., Detroit* 2.

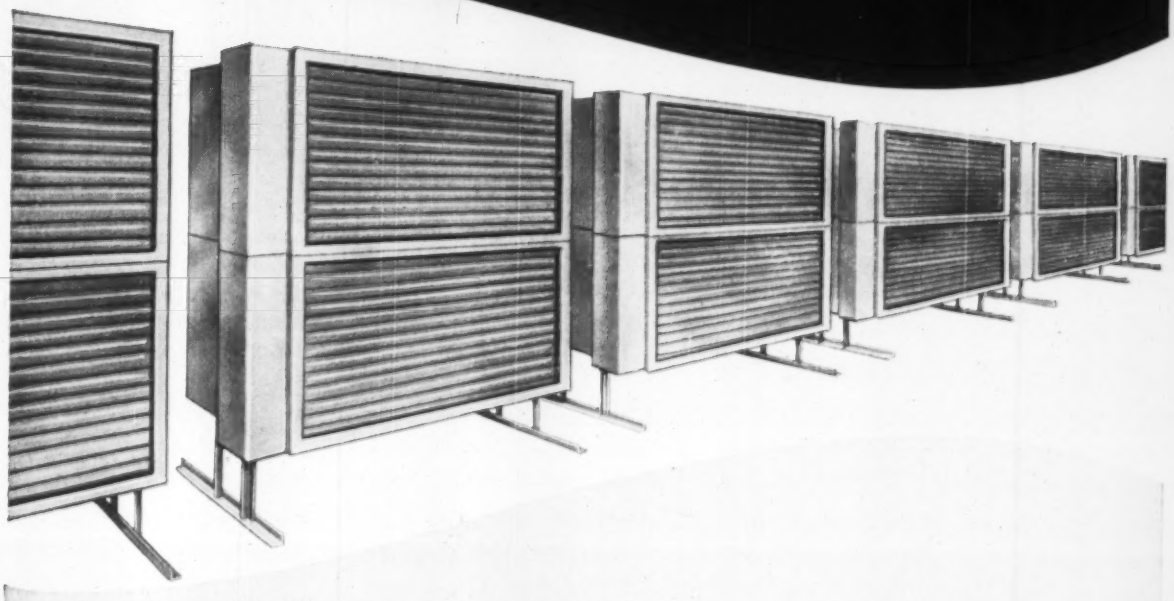
▸ *AIR CONDITIONING UNITS*—New catalog illustrates, describes company's air conditioning units including capacity data, physical data, dimensions. "Roomaire" conditioner is remote type designed for multi-room installations. *Young Radiator Co., Dept. HPAC, Racine, Wis.*

▸ *AIR MOVING UNITS*—Illustrated 16 page bulletin "No. 5412" describes special purpose air moving units for original equipment manufacturers. Over 50 packaged designs in photos and text. Products covered: centrifugal blowers, vaneaxial fans, tubeaxial fans, propeller fans, pressure blowers, fluid coolers. *American-Standard, American Blower Div., Dept. HPAC, Detroit* 32.

▸ *AUTOMATIC CONTROLS*—"Automatic Controls Catalog No. 26" describes, illustrates company's line of automatic controls for heating, ventilating and air conditioning control systems. New 52 page publication illustrated with photos, diagrams. Dimensions, specifications given in tables. *Barber-Colman Co., Dept. HPAC, 1300 Rock St., Rockford, Ill.*

KRAMER

UNICON for UNLIMITED TONNAGE



Kramer Unicon has brought a new era into the industry. With more than 20 years of unique practical experience and know-how in dry condensing, Kramer again offers new avenues of opportunity to the air conditioning and refrigeration industry.

Unicon now has no capacity limit. Standard Unicon systems up to 540 tons are now cataloged for the first time.

Unicons for heat pump applications are now also available with no horsepower limitations.

Kramer engineering and design has proven that the Unicon can move large volumes of air with extreme quietness.

Unicon has long proven by actual experience that it is free from fouling or corrosion and requires practically no maintenance.

The total operating weight per ton for Unicon is very low, resulting in minimum platform and reinforcement requirements.

Unicon space requirements are surprisingly small; a 300 ton system requires only 15′ x 14′ floor space and is 12′ high.

WRITE FOR BULLETIN U-391

KRAMER TRENTON CO. • Trenton 5, N.J.

44 YEARS OF CONTINUOUS ACHIEVEMENT IN HEAT TRANSFER

The ONLY

SQUARE-Round Neck AIR DIFFUSERS Made in ALL 3 Types

TYPE HAR—CONSTANT PATTERN

Adjustable Volume Control without Dampers!

Produces infinitely variable, effective air volume with constant horizontal pattern by moving control knob up or down. Ideal for all types of air-conditioning. Has built-in equalizing deflectors at no price increase.

TYPE HAV—ADJUSTABLE PATTERN

For equally efficient cooling, ventilating and heating; for ceilings or ducts. Blades within the cone are moved by turning smallest center cone; fine adjustment.

TYPE H-F FOR 1-2-3-4-WAY DIFFUSION

Made in all rectangular shapes to accommodate rooms of irregular shapes. Diffusion pattern is parallel to the ceiling. Design assures fast air mixture and equalized temperature. Extremely quiet operation.

Get Catalog #40 on this new diffuser line with superior performance characteristics.

FLEXIFLO **UNIVERSAL DIFFUSER CORP.**
38 Marbledale Road, Tuckahoe, N.Y.

RECENT TRADE LITERATURE

Continued

▸ *AXIAL FLOW FANS*—New, illustrated bulletin "No. 5802" covers new line of company's axial flow fans developed to provide high air displacement and pressure for cooling, heating, ventilating. Suggested applications, installations included. Table included listing characteristics such as capacity, static pressure, rotor tip diam, nominal hp, nominal speed weight. *Pesco Products Div., Borg-Warner Corp., Dept. HPAC, Bedford, Ohio.*

▸ *BOOSTER WATER HEATING*—"How to Design, Specify and Buy Large Volume Water Heating Systems" is title of refrence book with instructions, tables, charts to help estimate water heating requirements for various installations. Book also details controls, safety devices, accessories for each type of system. *Cleveland Heater Co., Dept. HPAC,* 2310 *Superior Ave., Cleveland* 14.

▸ *CONDENSER TUBES*—New publication, "Bulletin 415," explains how welded stainless steel heat exchanger and condenser tubes are made, points out fabrication and service advantages of using annealed tubing. *Babcock & Wilcox Co., Tubular Products Div., Dept. HPAC, Beaver Falls, Pa.*

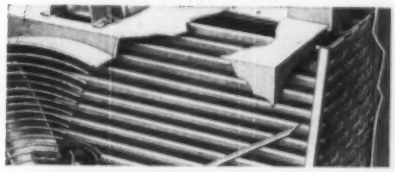
▸ *DEHUMIDIFIERS*—Revised, enlarged bulletin 37 describes company's line of coil type spray dehumidifiers. Illustrated, 16 page publication includes sections on engineering data, dimensional data, coil performance charts and psychometric chart. *Marlo Coil Co., Dept. HPAC,* 7100 *S. Grand Blvd., St. Louis* 11.

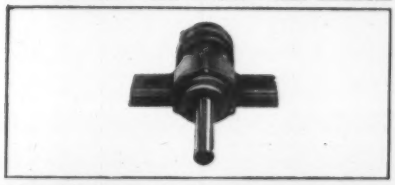
▸ *DEW POINT INDICATORS*—"Dew-O-metric" indicators discussed in new bulletin "No. 957." Design features, operation of unit given in text; dewpoint conversion chart included. *Anders-Lykens Corp., Dept. HPAC,* 1300 *E. Mermaid Lane, Philadelphia* 18.

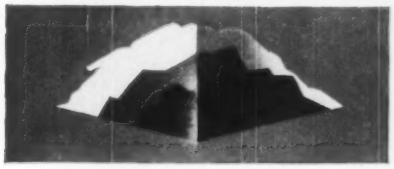
SO HALSTEAD & MITCHELL ENGINEERS SAID . . .

FOR LIKE-NEW PERFORMANCE YEAR AFTER YEAR— H&M COOLING TOWERS

Halstead & Mitchell Cooling Towers give rated performance even after years of operation







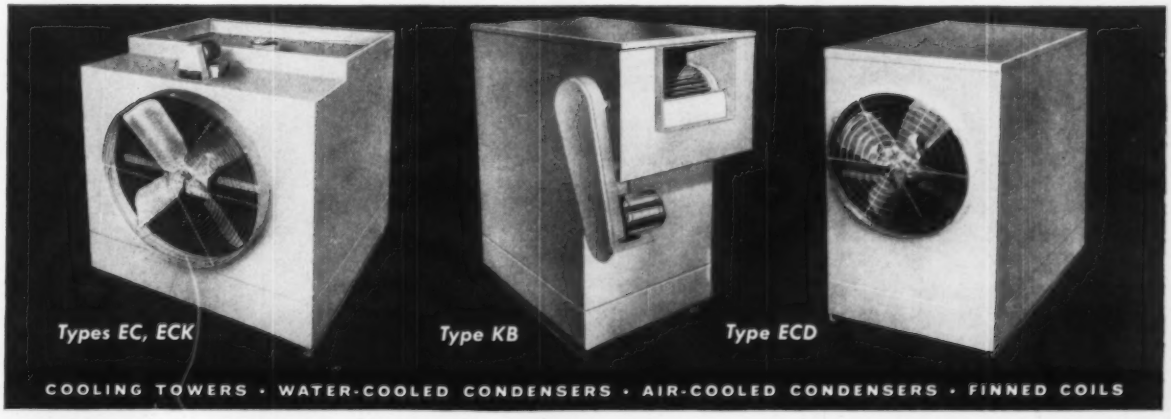
Special pressure creosoting of the wood fill prevents formation of fungus and algae which can build up and restrict the tower air flow, reducing system capacity. Only Halstead & Mitchell Cooling Towers carry a 20-Year Guarantee against failure due to fungus attack or rotting.

Sealed fan bearings are permanently lubricated, require no maintenance.

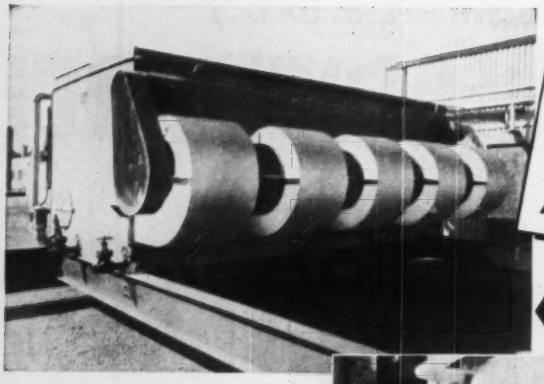
Tower housings are completely protected against corrosion by separate coatings of Vinsynite, Vinyl zinc chromate, and chlorinated rubber applied *after assembly*. Every edge, every corner is sealed against rust on all H&M Cooling Towers.

H&M Cooling Towers are available in propeller fan, centrifugal fan, belt drive, direct drive, and take-apart models. Capacities of 2 through 125 tons. For complete information contact your local distributor, or write to Halstead & Mitchell, Bessemer Bldg., Pittsburgh 22, Pa.

HM Halstead & Mitchell



COOLING TOWERS · WATER-COOLED CONDENSERS · AIR-COOLED CONDENSERS · FINNED COILS

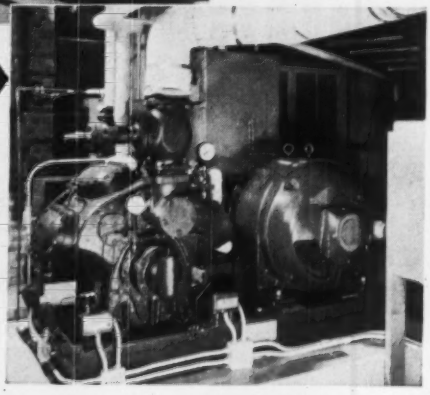


Vilter Report Card

Grade	Service Record
A	Efficient, alternating zone-load operation.
A	Exceptionally low operational cost.
A	Uninterrupted air conditioning service.
A	Smooth operation with minimum maintenance.

View of the Vilter VXF evaporative condenser located on the roof just outside the compressor room.

View of one of the two Vilter 8-cylinder VMC Freon compressors with a 100 h.p., 1175 r.p.m., part winding motor drive. These compressors are located on an upper floor, above an office.



Cool Thinking ... Cool Fun in Marquette University's Air Conditioned Brooks Memorial Union

Brooks Memorial Union is the hub of many Marquette University activities—professional meetings and conferences attracting a national audience, exciting school dances, excellent food facilities in the cafeteria, snack bar and private dining rooms. One key to its year-'round popularity and usefulness is the air conditioned comfort provided by the Vilter installation on this Milwaukee Campus.

To provide adequate air conditioning on a conservative appropriation and to minimize yearly operating expenses, the system was laid out to provide alternating zone-load cooling based on a "traffic flow" and usage pattern. During normal occupancy the entire Union is cooled. However, at peak loads only part of the conditioned space in Brooks Memorial is cooled at one time. As the peak occupancy load shifts from cafeteria and grill to the ballroom-conference room, the air conditioning is also shifted. Results of operating in this manner have been highly satisfactory.

Vilter equipment furnished on this job included two 8-cylinder VMC compressors; VXF Freon evaporative condenser; Freon liquid receiver; heat exchanger, cooling coils, motors, and controls.

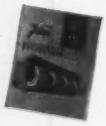
"Very satisfactory performance with only routine maintenance," is the praiseworthy comment by Marquette University officials.

Let Vilter help you with your air conditioning and refrigeration requirements.

Write for these helpful bulletins to: The Vilter Manufacturing Company Dept. F-804, 2217 S. First Street, Milwaukee 7, Wisconsin

Bulletin 631 Vilter Uni-Chiller

Bulletin 820 Vilter VMC Freon Compressors



Bulletin 732 VXF—VSC Evaporative Condensers

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REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin

Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines

RECENT TRADE LITERATURE

Continued

▸ *DUST COLLECTOR*—New 12 page bulletin "J-616" details company's "Microdyne" wet inertial dust collector. Publication illustrated with photos, cutaway drawings with performance curves, complete specifications. *Joy Mfg. Co., Dept. HPAC, Oliver Bldg., Pittsburgh* 22.

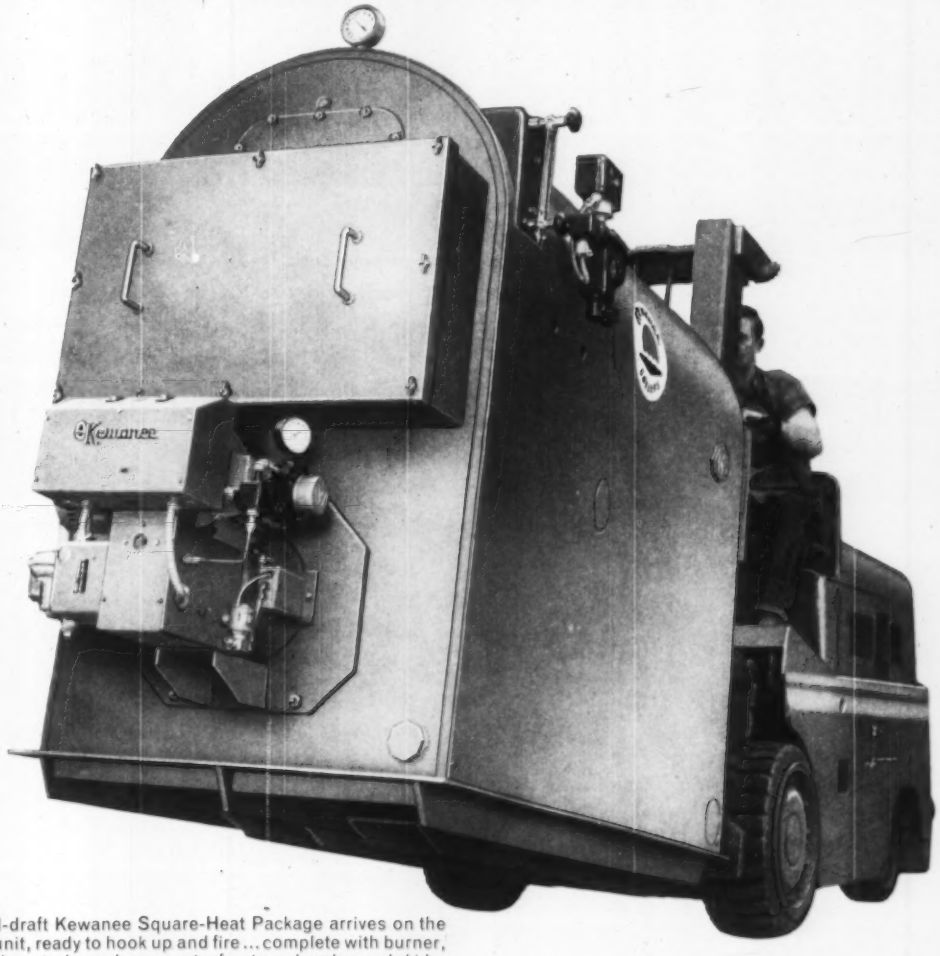
▸ *EVAPORATIVE CONDENSERS*—Reprints of address given by D. D. Wile, vice president and chief engineer of company, available. Included are comparisons of draw-through *vs* blow-through evaporative condensers; effective methods of bleed; analysis of test data on evaporative condenser performance; desuperheating coils; system performance and multiple-circuit condensers. *Recold Corp., Dept. HPAC,* 7250 *E. Slauson Ave., Los Angeles* 22.

▸ *FILTER WASH VALVES*—New 4 page technical bulletin "W-17" details surface wash water valves for filters. Operating layouts, operation, construction, dimensions of "G-A" control valves included with complete specifications. *Golden-Anderson Valve Specialty Co., Dept. HPAC,* 1210 *Ridge Ave., Pittsburgh* 33.

▸ *FLOW RATE INDICATOR*—Technical bulletin "No. 10A2235" describes "Ratosight" flow rate indicator with vibrationproof flow alarm switch for high and/or low flows. Specifications, dimensions given in illustrated publication. *Fischer & Porter Co., Dept. HPAC,* 600 *Warminster Rd., Hatboro, Pa.*

▸ *GAS REGULATORS*—Low pressure gas regulators for commercial, industrial heating equipment described with specifications performance data in new, 6 page bulletin "No. S-1012." Publication includes pressure drop and capacity chart, pressure drop graph, performance curves. *Maxitrol Co., Dept. HPAC,* 12200 *Beech Rd., Detroit* 39.

NOW . . . FORCED-DRAFT FIREBOX PACKAGES



Forced-draft Kewanee Square-Heat Package arrives on the job as a unit, ready to hook up and fire ... complete with burner, pre-wired control panel, pre-cast refractory chamber and skids. It requires no crating...no job-site insulating.

KEWANEE® SQUARE-HEAT GAS-OIL UNITS

for 15 lb. steam or 30 lb. water, 216,000 to 1,800,000 Btuh

For the first time, Kewanee offers a fire-box package boiler! The new Square-Heat Packages are forced-draft, requiring only a stub vent—no high stack. Kewanee's new combination gas-oil burner fires natural, mixed or L.P. gas . . . No. 1 or 2 fuel oil. One switch changes fuels . . . automatic changeover is available. An exclusive air distribution system pre-mixes gas and air before it enters the combustion chamber, for smoother and more efficient firing.

Along with the new burner is a new pressure-tight front flue cover dogged down by easily removed wing nuts . . . and a new, standard-equipment, wrap-around insulated jacket of heavy-gauge steel. Retained in the new units are Square-Heat's compact design, large firebox, widely spaced 3" fire tubes, large disengaging area and ample steam space.

For complete facts see your Kewanee Man or write: AMERICAN-STANDARD*, KEWANEE BOILER DIVISION, 115 Franklin Street, Kewanee, Illinois.

See this new Square-Heat unit among the display of Kewanee forced-draft packages at Booth 134, Power Show, New York Coliseum, December 1-5, 1958.

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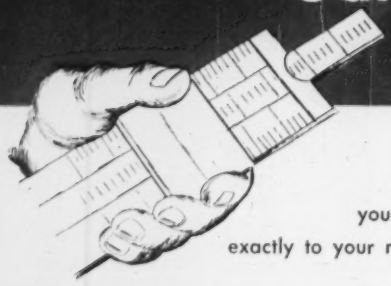
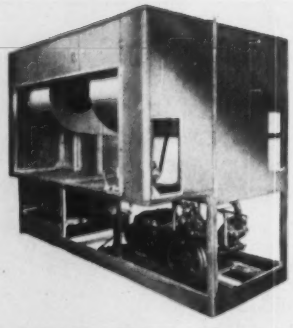


Yes, working with numerous basic models, Governair will incorporate your specifications and modifications to SATISFABRICATE the package exactly to your needs. You can be sure of its quality, too . . . for every Governair unit is constructed by expert craftsmen. This is your assurance of dependable performance and exact fit. Why not consult us on your next air conditioning project . . . from 3 to 100 ton units.



SELF-CONTAINED MULTI-ZONE AIR CONDITIONERS— with evaporative condenser. Zoned conditioner section — hot and cold deck, with mixing dampers for each zone. Sizes 7½ to 80 ton — single or dual refrigeration circuit. Ready for simple connection to duct system.

FAN AND COIL CABINETS — cooling, heating, humidifying, dehumidifying, ventilating, 1 to 100 ton, 500 to 30,000 cfm, vertical or horizontal types. Governair multi-zone fan and coil units are available in sizes ranging from 5 to 80 ton capacities, suitable for individual zoning.

Also: Blast Coils, Cooling Towers, Packaged Water Chillers, Low Temperature Coolers.

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RECENT TRADE LITERATURE

Continued

▶ *HARD RUBBER PIPE FITTINGS*—Illustrated 8 page bulletin "No. PF 1300" describes company's line of hard rubber pipe fittings and valves. In addition to information on characteristics, handling, etc., folder has diagrams, dimensions of threaded fittings, check valves, pet cocks, bibcocks, others. Physical properties and chemical resistance of construction materials given. *Luzerne Rubber Co., Dept. HPAC, Muirhead Ave., Trenton, N. J.*

▶ *INSULATION ADHESIVES*—Information on company's insulation adhesives, weatherproofing, coatings, vapor barriers, sealing compounds contained in new, illustrated bulletin "I-C 53." Facts on applications, properties, temperature ranges, coverage per gal included in publication. *Insul-Coustic Corp., Dept. HPAC, 42-23 54th Rd., Maspeth 78.*

▶ *MECHANICAL DRAFT FANS*—"Heavy Duty Mechanical Draft Fans" is title of 8 page brochure describing company's "Series 7000" centrifugal fans, designed to handle abrasive gases at high temperatures. Complete application, performance, physical data given with list of optional accessories. *Westinghouse Sturtevant Div., Dept. HPAC, 200 Readville St., Hyde Park, Boston 36.*

▶ *MOTORS AND CONTROLS*—New 27 page booklet, "Synchronous Motors and Controls," contains motor selector charts, application data, formulas for calculating power factor. Booklet presents quick summary of types, features of motors, controls, discussion of power factor correction, selection considerations, application problems. *Westinghouse Electric Corp., Dept. HPAC, Box 2099, Pittsburgh 30.*

▶ *MUSEUM OF AIR CONDITIONING*—Booklet describes company's *Museum of Air Conditioning and Refrigeration.* Many antiques of the

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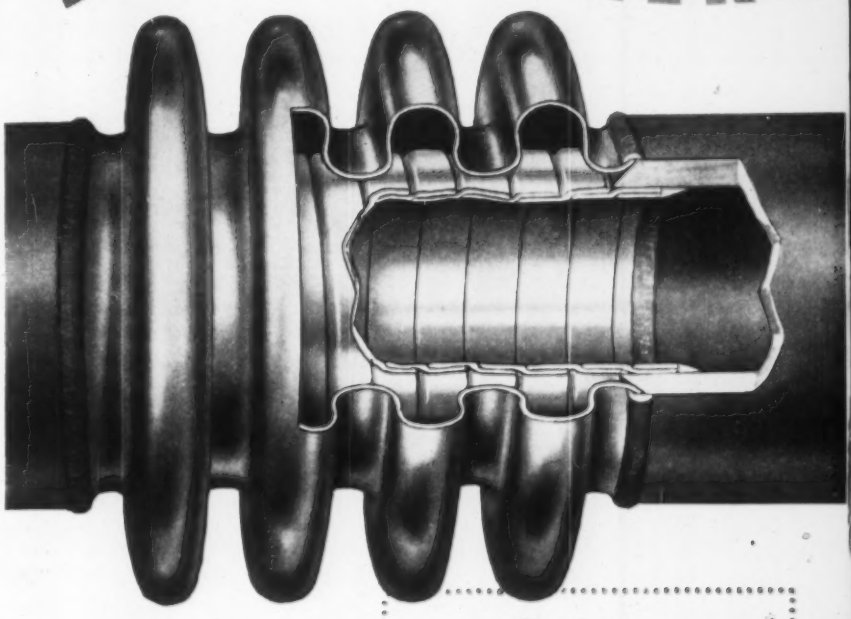

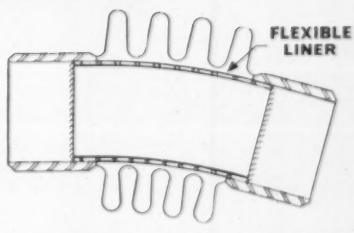

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Write today for facts about this new Flexon development—and your copy of the 28-page Flexon Expansion Joint Design Guide, the complete handbook for solving every problem in pipe motion.

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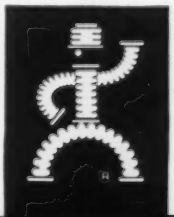

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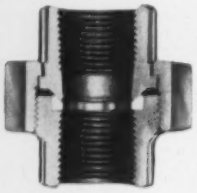

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RECENT TRADE LITERATURE

Continued

industry described in text, shown in photos. *Recold Corp., Dept. HPAC, 7250E. Slauson Ave., Los Angeles* 22.

▸ *OIL BURNERS*—Specification sheet covers company's new models in fully automatic oil burners. Capacities for new models range 3 to 33 gph. *Sun-Ray Burner Mfg. Corp., Dept. HPAC, 139-24 Queens Blvd., Jamaica* 35, *N. Y.*

▸ *OIL SEPARATORS*—Bulletin "No. 1057" describes function of "Prefilters" in eliminating entrained liquids and desiccant-clogging hydrocarbons from gas prior to dehydration. Table gives dimensions, specifications; text describes operation and design features. *Anders Lykens Corp., Dept. HPAC, 1300 E. Mermaid Lane, Philadelphia* 18.

▸ *PHOTO-DRAWING METHOD*—Publication describes "Photoneering," new process said to combine photography and drawing. Specifications drawn directly on photograph taken from any angle by using heat and humidity resistant plastic film sheet which permits changes or erasures, says manufacturer. Brochure explains process. *Technical Reproduction Service, Dept. HPAC, 375 South St., Newark* 5, *N. J.*

▸ *PIPE INSULATION*—New 8 page folder, "Form WPN-2," gives information on lightweight glass fiber "Micro-Lok" pipe insulation for temperatures from sub-freezing to 350 F. Publication gives physical properties, thermal conductivity, types of factory applied jackets. *L.O.F Glass Fibers Co., Dept. HPAC, 1810 Madison Ave., Toledo* 1.

▸ *PROCESS INSTRUMENTATION*—Recently issued, 8 page bulletin "No. 1000-R5" contains photos, operational data, design feature descriptions of 12 products for control of materials in motion. Wide range of

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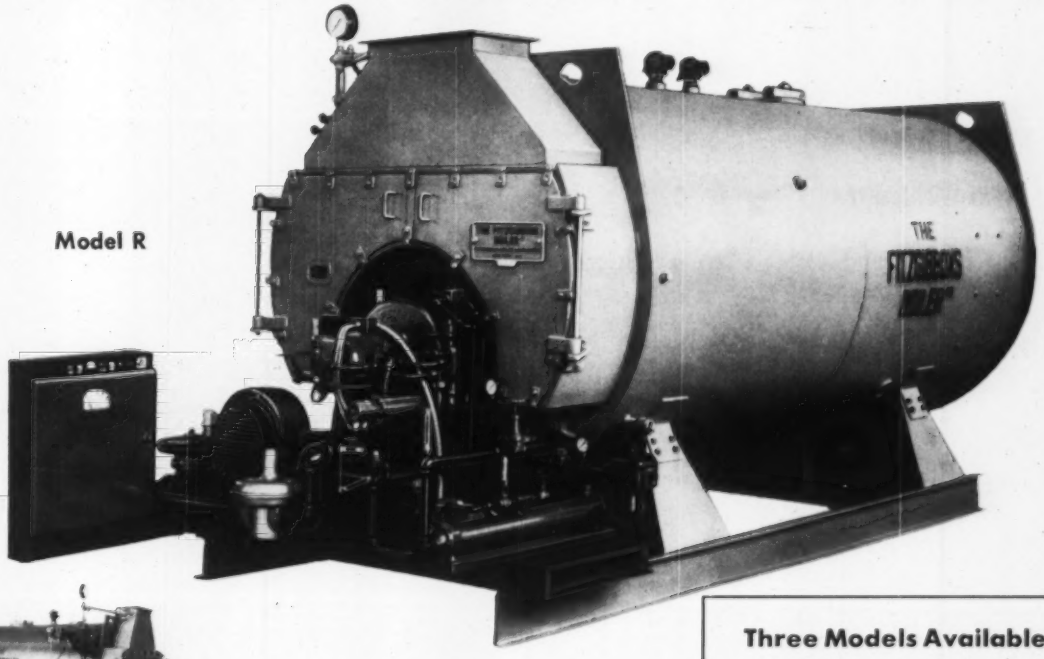
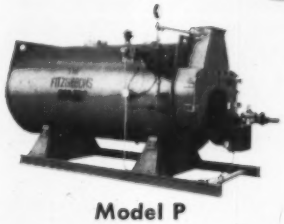
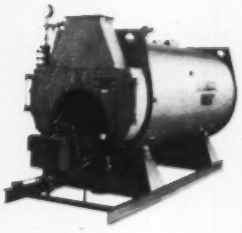
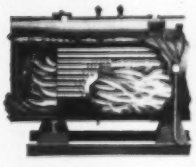




Model P



Model PB



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The burners are the quality product of a nationally known company and are excellently designed, easily serviced and field supported by an extensive service organization.

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RECENT TRADE LITERATURE
Continued

products discussed with reference to applications, design features, performance. *B-I-F Industries, Inc., Dept. HPAC, 345 Harris Ave., Providence, R. I.*

▸ *PROTECTIVE COATINGS FOR METALS*—New, 4 page folder describes "Ospho," new product developed to change rust to iron phosphate upon direct application. Product also said to provide good bond between metal and paint. *Rusticide Products Co., Dept. HPAC, 3125 Perkins Ave., Cleveland 14.*

▸ *PUMPS*—Line of condensate, turbine, boiler feed, centrifugal, proportioning, fuel oil pump and heater sets described, illustrated in bulletin "No. 9A." Six basic types shown with operational features, construction details. Illustrated with photos. *Walter H. Eagan Co., Inc., Dept. HPAC, 2336 Fairmount Ave., Philadelphia 30.*

▸ *REFRIGERANT DISTRIBUTORS*—Bulletin "20-10" covers company's line of refrigerant distributing devices, also contains section for reverse cycle, hot gas defrost, hot gas bypass systems. Application, selection, specifications given with dimensional line drawings. *Sporlan Valve Co., Dept. HPAC, 7525 Sussex Ave., St. Louis 17.*

▸ *RELIEF UNITS*—Illustrated folders give details on patented automatic heat, smoke, explosion relief unit. Operation explained with photographs, engineering specification information. *Swartwout Co., Dept. HPAC, 18511 Euclid Ave., Cleveland 12.*

▸ *RENEWABLE AIR FILTER*—"Far-Air Roll-Kleen," an automatic renewable media air filter described in 8 page bulletin "B 1400-2A" with detailed information on unit's component parts. Operation controls, engineering data, maintenance factors for unit also given. *Farr Co., Dept.*

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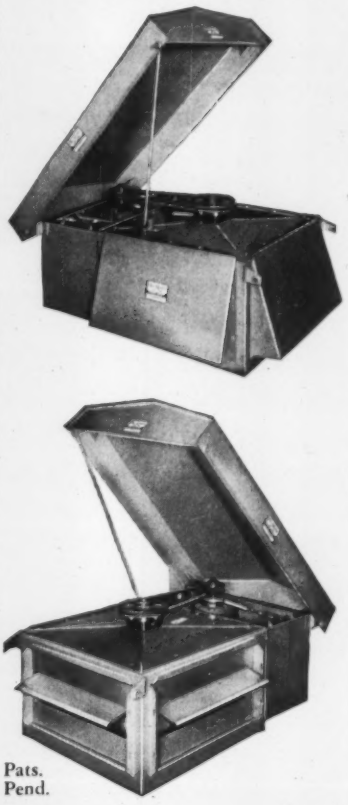

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Motor mounting on side of structure support . . . out of line of air stream reduces height of Lo-Boy models nearly 50% of older designs.

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SIZES 10"-72" 600-47,000
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Remember . . .

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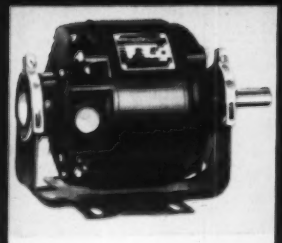

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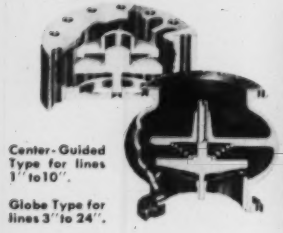

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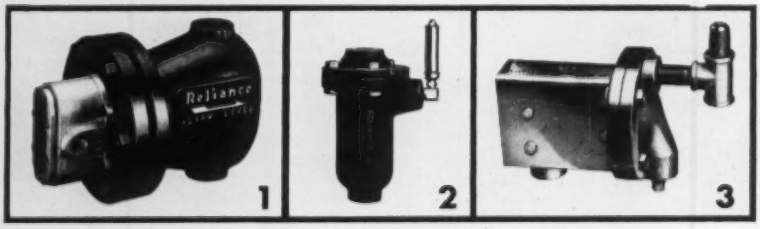

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HPAC, P. O. Box 45187, *Airport Station, Los Angeles* 45.

▸ *ROOF VENTILATORS*—Illustrated 34 page catalog "V-58" describes company's line of direct and belt driven centrifugal fan models, propeller direct drive and outdoor air intake. Illustrated with engineering drawings, performance graphs with data on capacities, performance. *Carnes Corp., Dept. HPAC, Verona, Wis.*

▸ *SCOTCH-TYPE BOILER*—Illustrated 4 page brochure presents scotch type low pressure boiler, shows full wet back construction, smoke box, gasketed rear door. Capacities and dimensions of 13 sizes also included. *Portmar Boiler Co., Inc., Dept. HPAC,* 193 *Seventh St., Brooklyn* 15.

▸ *SOLAR SCREENS*—Illustrated bulletin describes new line of ceramic veneer grilles for solar screens. Eight standard designs presented in diagram and pattern drawings. Available in variety of colors. *Federal Terra Cotta Corp., Dept. HPAC,* 10 *E. 40th St., New York* 16.

▸ *STAINLESS STEEL FITTINGS*—New 86 page reference volume on stainless steel pipe fittings gives information on broad line of IPS and tube OD welding fittings, screwed and socket fittings, ASA, MSS and corrosion weight flanges. Technical section includes data on manufacturing standards, specifications, data on welding of stainless steel and corrosion resistance tables. *Ladish Co., Dept. HPAC, Cudahy, Wis.*

▸ *STEEL TUBING*—New 10 page bulletin "No. 756" describes manufacture, types, applications of company's line of steel tubing. Illustrated with photos, diagrams. *Nikoh Tube Co., Dept. HPAC,* 5000 *S. Whipple St., Chicago* 32.

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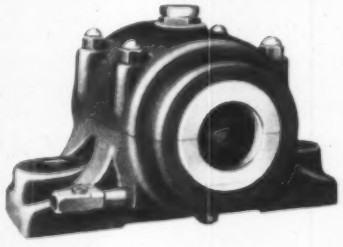

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One factor that contributes to the dependability of this steady power supply is the bearing that insures unfailing operation of mechanized draft in the generating plant.

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CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

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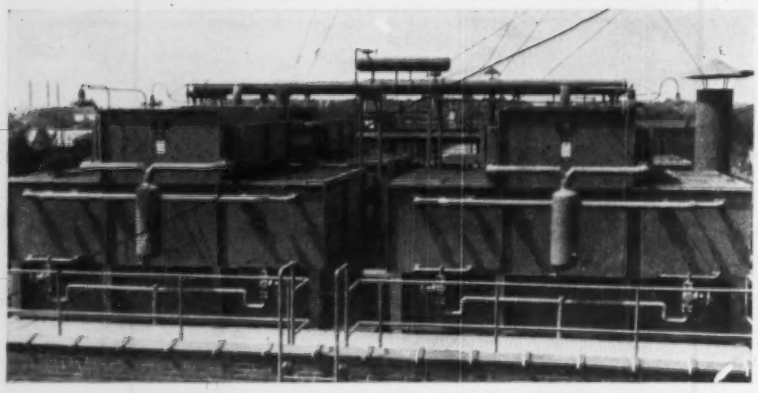

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Niagara District Engineers in Principal Cities of U. S. and Canada

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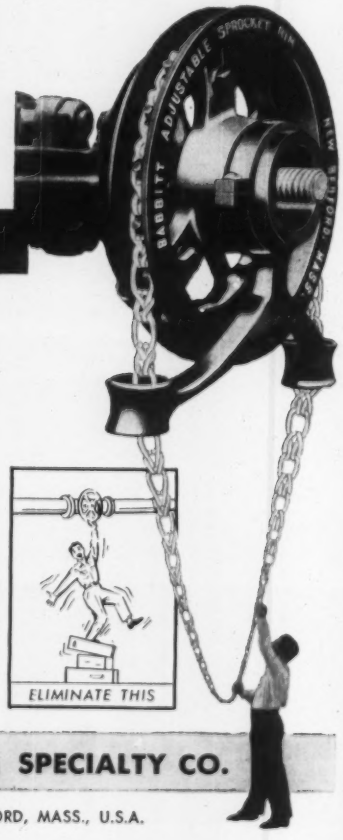

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▸ *STEEL UNIONS*—New, looseleaf, 16 page catalog contains information on construction, performance of company's line of orifice unions, check valves, forged steel fittings, ranging 2000 through 6000 lb CWP. *Clayton Mark & Co., Dept. HPAC,* 1900 *Dempster St., Evanston, Ill.*

▸ *TANKLESS WATER HEATER*—New 1958 catalog describes company's "WH" series twin coil volume water heater designed to supply quantities of automatic hot water without storage tank. Capacities, dimensions chart lists proper size water heater for various applications. *Portmar Water Heater Co., Inc., Dept. HPAC,* 193 *Seventh St., Brooklyn* 15.

▸ *TEMPERATURE CONTROL*—Technical information on "Type B27A" dual switch temperature control for gas, air or hot plate applications given in recently released bulletin. *United Electric Controls Co., Dept. HPAC,* 79 *School St., Watertown, Mass.*

▸ *TEST EQUIPMENT*—Brochure "No. 2060" covers line of test equipment, including volt-ohmmeters, vacuum tube volt-ohmmeters, microtesters, refrigeration and air conditioning test equipment. Bulletin illustrated with photos. *Simpson Electric Co., Dept. HPAC,* 5200 *W. Kinzie, Chicago* 44.

▸ *TUBEAXIAL FANS*—Performance, dimension specifications on company's "300" tubeaxial fans available in new catalog "1110B". Illustrated 17 page publication charts stack sizes, maximum hp, motor speed for variable stack velocity and cfm output. *Westinghouse Electric Corp., Sturtevant Div., Dept. HPAC, Hyde Park, Boston* 36.

▸ *VAPOR CONDENSER*—Bulletin "No. 139R" describes company's vapor condenser sectional models in

PERFECT FIT *and* PROPER FUNCTION

CONNOR ENGINEERING CORPORATION

kno·draft® AIR DIFFUSERS

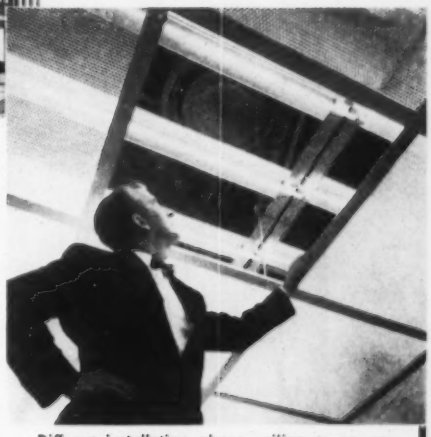
FOR THE NEW REYNOLDS METALS BUILDING

ARCHITECT—SKIDMORE, OWINGS & MERRILL, NEW YORK, N.Y.
ENGINEERS—EBASCO SERVICES, INC., NEW YORK, N.Y.
CONTRACTOR—HUFFMAN-WOLFE SOUTHERN CORP., CHARLOTTE, N.C.

Connor engineers and equipment solved a unique two way air conditioning problem at the new Reynolds Metals office building, Richmond, Virginia.

A. Functionally, Connor equipment permitted *complete* concealment of *both* the air diffusers and return registers above a grid ceiling, with proper air distribution assured.

B. Architecturally, Connor equipment, where necessarily exposed, hardly reveals its purpose by stylistically conforming with the striking simplicity of the building's interior.



Diffuser installation above ceiling is an engineering accomplishment previously believed unworkable.

Pre-installation tests conducted at Connor's laboratory proved conclusively that the high degree of air entrainment produced by the Kno-Draft single stream diffuser satisfactorily would move air upward through the grid ceiling, where it would mix thoroughly with the supply air, and provide the areas below with constant, highly efficient air conditioning. And since installation, the equipment has been serving the Reynolds building to complete satisfaction.

Contact Connor for recommendations on your air distribution problems . . . common or uncommon. Our research and long practical experience guarantees you constant comfort conditions.

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A standard Kno-Draft diffuser in an office area.

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The above ceiling diffusers and the specially designed round and slotted units perfectly fulfilled stylistic requirements.
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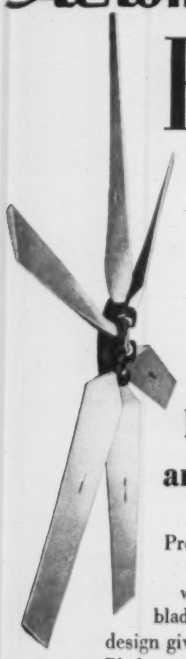

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RECENT TRADE LITERATURE

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4 pages illustrated with photos, diagrams. Functions explained; capacity curves provided for eight sizes; table of dimensions, weights included. Designed to condense vapors in closed system with 7 or 8 deg F subcooling, maintaining high vacuum. *Niagara Blower Co., Dept. HPAC,* 405 *Lexington Ave., New York* 17.

▶ *VARIABLE SPEED DRIVES*—Color illustrated, 16 page booklet "D-2506" describes manufacture, operation, applications of company's line of variable speed drives. Bulletin also lists condensed drive specifications, dimensions, accessories. *Reliance Electric and Engineering Co., Dept. HPAC,* 24701 *Euclid Ave., Cleveland* 17.

▶ *WATER HEATERS*—"The Inside Story" is title of booklet issued by manufacturer to describe features, principles, manufacture of immersion water heaters. Section headings include: "What about this Business of Immersion Heating?"; "Design Features"; "Advantages"; "A Big Cut in Installation Costs"; "No Draft Problems"; "Gas in Summer, Steam in Winter." *Sellers Engineering Co., Dept. HPAC,* 1876 *N. Clark St., Chicago* 40.

▶ *WELDING FITTINGS AND FLANGES*—"Technical Bulletin FDC-266" presents dimensions, diagrams of company's welding fittings and forged steel flanges in 12 in. nominal pipe size Dimensions, specifications given in tabular form. *Babcock & Wilcox Co., Tubular Products Div., Dept. HPAC, Milwaukee* 46.

▶ *WELDING SUPPLIES*—Illustrated 52 page welding supplies, accessories catalog "ADC 848 C" complete line of fluxes and ferrous, nonferrous rods for gas welding and accessory items. *Air Reduction Sales Co., Div. of Air Reduction Co., Inc., Dept. HPAC,* 150 *E. 42nd St., New York* 17. ≠

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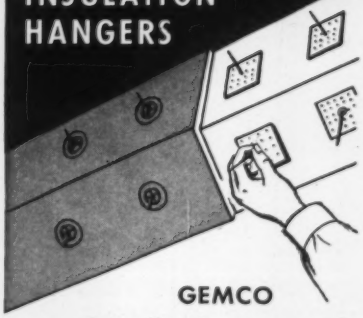
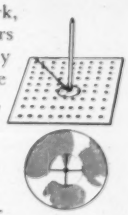


GEMCO Spindle Hangers and W-A Self-Locking Washers

Ideal for insulation work, Gemco Spindle Hangers are easily and quickly installed... with positive adhesion to concrete, brick or metal. W-A Self-Locking Washers pressed over spindles with minimum effort and lock insulation securely in place.



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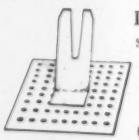

Designed especially for supporting various types of block insulation. Easily applied for positive adhesion. Prongs (available in various lengths from 1 3/16″ to 6 7/8″) bend over to hold insulation firmly in place.

TUFF-WELD Nylon Hangers

Two-piece hangers... with bases of tough, mold nylon and spindles of metal. Made especially for smooth surfaces. Spindles snapped into bases as needed; reduces inventory, storage space, freight costs. W-A Self-locking washers hold insulation securely in place.

TUFF-BOND Quik-Set Adhesive (for smooth or slightly irregular surfaces) and General Purpose Adhesive (for rougher surfaces) assure permanent adhesion of hangers when used as directed. Write or wire for details and specifications.

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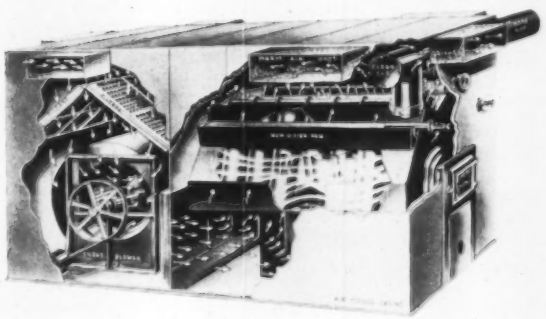
You can be sure of outstanding performance at surprisingly low cost when you specify Campbell Warm Air Heaters. This performance pays dividends in customer satisfaction and increased business for you. Campbell Heaters are easy to install. They deliver exceptional fuel economy; give long, dependable service. We invite you to let Campbell engineers help you figure on your next large heating job.



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We have some attractive openings for men calling on heating contractors and architects.

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DES MOINES 17, IOWA

PROBLEM:

To find a commercial-type register with four way air-direction control plus volume control, that will work in standard 3¼" duct.

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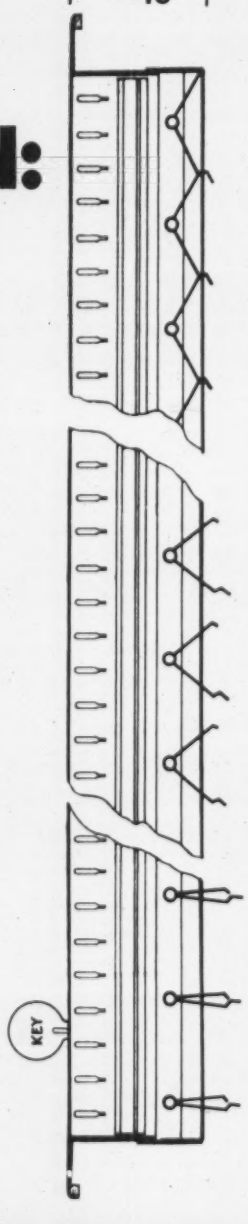

SOLUTION:

AIR CONTROL'S *Multi-Trol* Registers have exclusive **Shallo-Valve** – fit fine in 3¼" duct, leaving plenty of space for full air volume. And note how this patented butterfly valve action provides positive air volume control – assures even air distribution over register face at any setting. Seals *tight* when closed – can't whistle or rattle.

Ideal for both heating and cooling in commercial and deluxe residential installations, Air Control's *Multi-Trol* registers feature fully adjustable face bars for 2-way or 4-way control of air pattern. Bars have air foil shape and are locked to side margins – can't come loose. Complete range of style and sizes. Attractive beige prime coat.

FREE '58 CATALOG SHOWING COMPLETE AIR CONTROL LINE — SEE YOUR JOBBER OR WRITE US.

AIR CONTROL PRODUCTS, Inc.
358 Center St., Coopersville, Michigan

"OPEN FOR DISCUSSION"

(*Continued from page 88*)

used by Mr. Turner, let's set some conditions and compare them with the study. Let the fuel be oil or gas. Assume that there are no controls other than those commonly in use. Checking the technical data available on steel boilers, (the author has also compared package boilers and cast iron boilers) and assuming that the same boiler is being used by Mr. Turner, the following data is learned: for each 1 in. variation in water level from normal, a change in the capacity equal to approximately 12.6 gal occurs. The water level is assumed to vary no more than 3 in. up or down as a maximum. This boiler is being fired to develop only 100 percent of SBI rating or the maximum output is 1 million Btu per hr. This fixes the evaporation rate at a maximum of 2.1 gpm, or 21 gal every 10 min. The time for the water line to drop 1 in. then is 12.6/2.1, or 6 min.

Now, let's see how long the boiler could operate and use a condensate return system which, according to the rule in the article, is where makeup water added would raise the water level no more than 2 in. If, on a water feeder-low water cutoff combination set normally, no makeup water is added during the first 6 min, after 6 min the drop goes over the 1 in. variation and should start the feeder. Then, for the next 12 min, the properly sized feeder could add enough water to raise the normal water level only 2 in.

Consequently, the boiler could operate on a condensate return system where the system time did not exceed 18 min. If the system time were longer than 18 min, then the engineer would have to decide whether to gamble that the boiler operator would not drain down the water to normal level, thus bringing about the condition of washed water, excess scale, etc., the very problem involved in this study.

As an interesting sidelight, this same boiler is often used to develop more than 100 percent of SBI rating. It is often recommended that the boiler be fired to develop 150 percent so that, in an emergency or for future growth, the capacity is there, as well as quick response. This imposes a different condition on the 18 min system. The evaporation rate is now 3.05 gpm and the time to lower the water level time for 1 in. is reduced to about 4.2 min so that, at 12.6 min, the boiler is still 5.4 min away from its needed condensate.

If only this makeup is wasted each day which is the equivalent of 1¼ in. in water level or 5.4 min operation, it is sufficient to completely change the water in the boiler every 22 working days. This is understandable in a boiler being used on process work where high steam usage is required and a lot of makeup is required, but not in a system considered closed where 100 percent condensate is returned.

To date, the author is not aware of a satisfactory method of doing as Mr. Turner has suggested. Storage of condensate under automatic control is either in the

GILSULATE® Pipe Insulation Digest

FOR UNDERGROUND HOT PIPES

Solving insulation problems for schools

Booming school construction is with us now, and will be for years to come, according to all available surveys.

But limited budgets...in the face of demands for more and more classrooms... pose an important problem for school boards on every educational level.

As a result, many architects turn to prefabricated and modular construction, and multi-purpose use of space. Corridors are shortened...overall areas are shaved... portability, flexibility and expandability of all design elements are emphasized.

And to save costs in heating plants... without impairing efficiency or performance...there is a definite trend to high temperature, hot water heating systems.

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Hundreds of school and college GILSULATE installations include high temperature hot water, low temperature hot water and conventional steam systems. Many are sizable installations on new college campuses...like the University of Connecticut (shown below) where extensive campus expansion is now under way.

And there are innumerable elementary and secondary schools in every state... where only a few tons of GILSULATE have been needed to adequately protect the underground hot pipe lines of relatively small systems.

GILSULATE is popular with architects, engineers and school boards, because it does its lifetime insulating job thoroughly ...and keeps school costs low.

GILSULATE's record for helping reduce classroom costs is impressive. In two instances, combined with skillful architectural design, GILSULATE installations helped to bring classroom costs down to $10,000 and $11,000 per room—far below the estimated national average of $30,000!

Costs are held down by GILSULATE, because it is poured in place and requires no special handling or installation procedure.

Specific grade-school-to-college installations are illustrated in an issue of PIPE INSULATION NEWS devoted to schools. Send coupon below for your copy.

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Brings lifetime protection to underground hot pipes

Since its nation-wide introduction in 1952, the tonnage of GILSULATE used has multiplied many times each year. Today there are hundreds of miles of pipe protected for life with GILSULATE...in thousands of installations.

What brought this phenomenal growth? Simply this: GILSULATE is of high insulating efficiency...permanently protective...easy to install...completely dependable...low cost.

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He's a good man to see when you are planning a school heating system. Your distributor is well-versed in underground hot piping systems and, particularly, in local construction problems. He will gladly arrange for you to visit school jobs in your area which have been insulated with GILSULATE.

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Send me your Schools' Issue of PIPE INSULATION NEWS and add my name to your mailing list.

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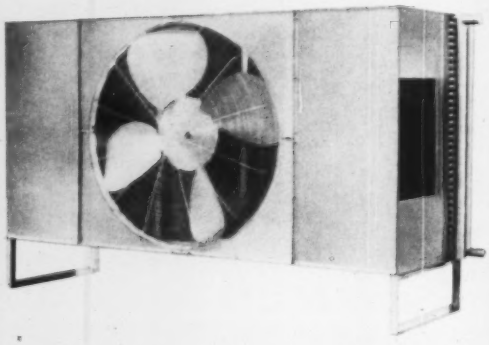

STANDARD SELF-CONTAINED, REMOTE MODELS, 3 TO 25 TONS. RANGE UNLIMITED BY DUPLEXING. INDOOR-OUTDOOR REFRIGERATION OR AIR CONDITIONING JOBS! "DRAW-THRU" PRINCIPLE. TOTALLY ENCLOSED MOTORS. FANS, NAFM-RATED. FAN GUARDS HEAVY WIRE, 'N PLATED. ANGLE-IRON MOUNTING STAND. FEATURES GALORE, ASK US MORE.

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"OPEN FOR DISCUSSION" *Continued*

boiler or in a condensate receiver. If the water is held in storage in a condensate receiver, then it is necessary to know the capacity required for the tank.

Mr. Turner advocates the use of a feeder at a point below the normal operation level and at the lowest safe water line. This practice is rather specialized and at odds with a great many facets. The main problem would be to determine "the lowest safe water line." The next would be to get it installed there. The subsequent problem would be to educate every operator and succeeding operator as to why it was located there. The last would be getting them to leave it where you wanted it.

The author has had negative experience with water feeders mounted in conjunction with pump control-low water cutoff combinations. For some reason, in too many cases, the water feeder gets mounted higher than the pump control and has been a source of flooded receivers. In the many jobs checked out for the study, these jobs were all discounted except for the method.

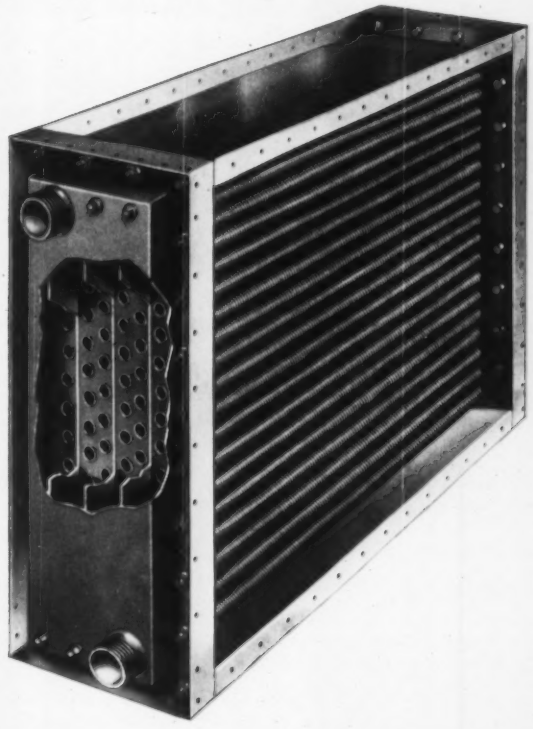
On manual feeding of makeup water: This is a rejection of automatic controls on Mr. Turner's part and is considered as opinion only, with no other comment.

The points mentioned here seem to be mostly side points, in the opinion of the author. The real meat of the article is in the acceptance of the family of curves as a satisfactory means of predicting the system time. It is the feeling of many engineers that if they are given a method with reasonable accuracy, they will use it rather than guess by rule of thumb.

The method outlined in the article has been of more than reasonable success to the author. It has been studied by the ASHAE technical advisory committee on hot water and steam heating, and checked out by the ASHAE research laboratory for originality and accurateness as well as to try to find where someone else might have done something of a similar nature. For the last 35 years no publication was found similar to the study, except the rule of thumb found in the ASHAE Guide on sizing condensate receivers.

The tables and recommendations are as used by the author to illustrate how the sizing tied in with the curves and time predictions. It is not impossible that some engineers would be confused. But, by the same token, they will not be confused if they are fully aware of the problem. If the table is accepted as it is now, the author will be greatly surprised. Very few first tables ever end up being the accepted method. This is a working tool and the more it is used the more useful it becomes. The more it is studied, the more refined it can get. Discussion is welcome. However, all the factors should be considered in this as with any engineering problem.

Tom E. Krieg
Engineer
Denver, Colo.



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- **Complete Drainability**
- **Easily Cleaned**
- **High Heat Transfer**

Completely drainable and easily cleaned, Aerofin Type "R" coils are specially designed for installations where frequent mechanical cleaning of the inside of the tubes is required.

The use of ⅝" O. D. tubes permits the coil to drain completely through the water and drain connections and, in installations where sediment is a problem, the coil can be pitched in either direction. The simple removal of a single gasketed plate at each end of the coil exposes every tube, and makes thorough cleaning possible from either end.

The finned tubes are staggered in the direction of air flow, resulting in maximum heat transfer. Casings are standardized for easy installation.

Write for Bulletin No. R-50.

AEROFIN CORPORATION

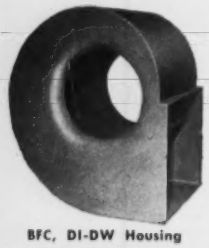
101 Greenway Ave., Syracuse 3, N. Y.

Aerofin is sold only by manufacturers of fan system apparatus. List on request.

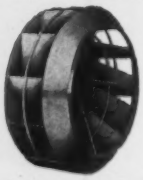
Make
BARRY
BLOWER COMPANY
your dependable low cost source of supply for
POWER FAN EQUIPMENT

BFC, DI-DW Wheel

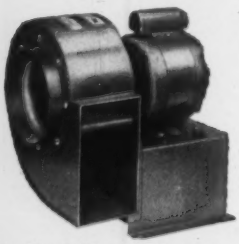
We offer users of power fan equipment a full line of blowers, multiple blower assemblies, direct and belt driven ventilating sets, cast iron blowers and various types of centrifugal blower wheels and housings. All sizes from 6" to 73".

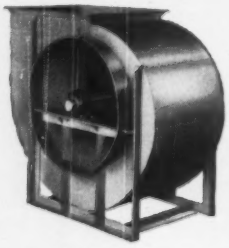

BFC, DI-DW Housing

ALL BARRY blower wheels and housings are precision made from steel, aluminum, brass, copper or stainless, and are expertly balanced and trued before shipment.


BBI Blower Wheel SI-SW, Class 2.

We make power fan equipment *exclusively*, and do not compete with our own customers . . . . . and, we have a high reputation for dependable quality and remarkably fast deliveries. Let us quote on our standard equipment, or upon your special sizes and specifications. Write us today.


Direct Drive, All-Purpose Utility Blower


BBI Blower, SI-SW Arrangement No. 3, class 4

★ A few territories are available for qualified sales representatives.

BARRY BLOWER CO.

3100 California Street N.E. • Minneapolis 18, Minnesota
Member: Air Moving and Conditioning Association, Inc.

WHO'S WHAT . . .

(New personnel, promotions)

▸ *CHRYSLER CORP., AIRTEMP DIV.*—Paul M. Augenstein, president; Joseph B. Ogden, vice president in charge of sales.

▸ *KEASBEY & MATTISON CO.*—Edward J. Buczkowski, vice president—production; Robert A. Schneider, vice president—engineering; George Barge, treasurer, elected to board of directors; Albert F. Humlhanz, assistant treasurer.

▸ *TRION, INC.*—R. R. Pryor, vice president—sales.

▸ *OAKITE PRODUCTS, INC.*—Eustace Lingle, vice president in charge of industrial sales and education.

▸ *FLEXONICS CORP.*—Edward A. Malling, vice president of marketing; Peter H. Lauer, treasurer.

▸ *INTERNATIONAL NICKEL CO., INC.*—Albert P. Gagnebin, vice president; Joseph M. Weldon, assistant vice president.

▸ *JOHN WOOD CO.*—J. H. Gotwals, senior vice president and general manager of heater and tank division.

▸ *JOSEPH T. RYERSON & SON, INC.*—Hardie W. Beck, general manager of Pittsburgh plant; John A. Houston, assistant general manager of Philadelphia steel service plant.

▸ *ORR & SEMBOWER, INC.*—Sam N. Craig, chief engineer.

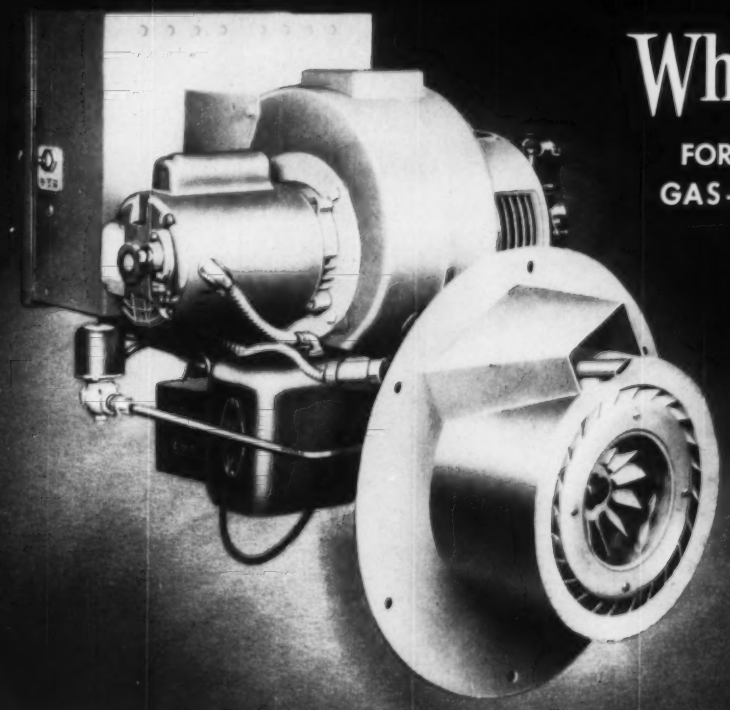
▸ *BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE CO.*—Paul G. Thayer, chief engineer of advance development department.

▸ *UNITED SHEET METAL CO., INC.*—William M. Harmon, chief engineer.

▸ *DUNHAM-BUSH, INC.*—James A. Mulcahey, elected to company's board of directors.

▸ *L. O. F GLASS FIBERS CO.*—R. H. Barnard, Jr., manager of firm's pipe insulation plant in Defiance, Ohio.

Another new development by Iron Fireman



WhirlBlast

FORCED DRAFT GAS-OIL BURNER

Now...forced draft firing for smaller boilers

The Iron Fireman WhirlBlast gas-oil burner was created to fill the need for forced draft firing in all types of medium size boilers and particularly for the increasingly popular sealed firebox Scotch boiler. Now you can have the advantages of forced draft firing in boilers as small as 18 bhp. The necessity for costly and unsightly smokestacks has been eliminated. All air for combustion is supplied by the burner blower. No extra motors, fans or draft ports are required.

No pulsation

A newly developed firing head has solved the old problem of flame pulsation. This has been accomplished without recourse to firebox vents or other alterations.

Outstanding features of the WhirlBlast burner

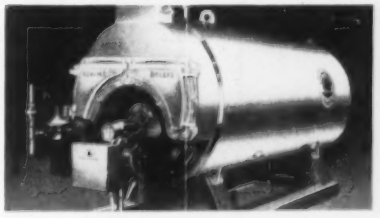
1. Switches fuels instantly. Fuels can be changed automatically with appropriate controls, or manually by the flick of a switch.

2. No high smokestack. A stub stack or vent is all that is required.

3. For all types of boilers. Fires sealed firebox boilers under pressure. Also greatly improves draft conditions in natural draft boilers.

4. Easily installed. Available with either a flange or pedestal mount. Bolts directly to the boiler front. Inverted model (with draft tube on top) permits mounting on Scotch boilers without interfering with flue doors.

5. Fuels. Fires No. 2 fuel oil and all types of fuel gas. Available in either oil, gas or dual fuel models.



Complete package ready to operate — boiler, burner, controls

Complete boiler-burner units assembled, wired and tested at the factory. Totally enclosed control panel is built into the burner. Wide range of sizes; easily specified by model number.

IRON FIREMAN®

AUTOMATIC FIRING EQUIPMENT FOR HEATING, PROCESSING, POWER

For more information, mail coupon

IRON FIREMAN MANUFACTURING COMPANY
5088 West 106th Street, Cleveland 11, Ohio.
(In Canada, 80 Ward Street, Toronto, Ontario)

Please send more information and specifications on the Iron Fireman WhirlBlast burner.

Name_____

Firm_____

Address_____

City_____ Zone____ State____

They compared "K" factors and cost factors . . . and bought SNAP*ON®

FOR FREE TEVA SURVEY CALL YOUR LOCAL G-B SNAP*ON DISTRIBUTOR (LISTED IN YELLOW PAGES)

Compare cold line applications, for example — for thermal efficiency, economy and ease of application, you, too, will find that there is nothing like Snap*On, the one-piece pipe insulation molded of fine glass fibers. It is available in a wide range of sizes from copper tubing to 36″, with factory-adhered vapor barrier jackets, ready to snap quickly on the pipe, easy to seal on bends and seams. Snap*On's thermal efficiency rates at the top of all general purpose pipe insulations — and it is *permanent*.

For many of the same reasons you will want to specify Snap*On for heated lines up to 350°. For a free analysis of your pipe insulation requirements — and a cost comparison with other insulations — just ask your G-B distributor for a TEVA (Thermo-Economic Value Analysis) survey the next time you insulate hot or chilled lines.

GUSTIN-BACON *Manufacturing Co* GUSTIN gb BACON

220 W. 10th St., Kansas City, Mo.

Thermal and acoustical glass fiber insulations • Pipe couplings and fittings • Molded glass fiber pipe insulation

WHO'S WHAT

Continued

▶ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—F. W. Borse, manager of Commercial Division's service and installation department; H. S. Olsen, manager of company's Chicago plant; Hal Canoyer, product promotion; William Wray, product sales manager of electrical products.

▶ *VAN-PACKER CO.*—Bill Henson, assistant sales manager.

▶ *CLAYTON MARK & CO.*—Joseph C. Lowey, general manager of sales.

▶ *YOUNGSTOWN SHEET AND TUBE CO.*—J. R. McReynolds, assistant district traffic manager.

▶ *HOBART BROS. CO.*—Howard B. Cary, director of technical school.

▶ *ROBERTSHAW-FULTON CONTROLS CO.*—Louis J. Casillo, production manager of *BRIDGEPORT THERMOSTAT DIV.*; Herbert H. Cooper quality control manager of same division.

▶ *F. E. MYERS & BRO. CO.*—Fred Simmons, sales manager; Donald E. Brubaker, sales administration manager; Donald H. Paulson, marketing research manager.

▶ *GENERAL DYNAMICS CORP.*—Rene A. Vanina, assistant division manager of sales for the corporation's *ELECTRO DYNAMIC DIV.*

▶ *AMERICAN-STANDARD PLUMBING AND HEATING DIV.*—William Lanxner, supervisor, media and product publicity.

▶ *WRIGHT MFG. CO.*—Joseph A. Nuber, director of advertising and sales promotion.

▶ *JAMESBURY CORP.*—Van R. French, production manager.

▶ *GIBSON REFRIGERATOR CO.*—Milo J. Chavez, manager of central air conditioning sales; Charles D. Seltzer, field sales manager of room air conditioners.

▶ *DRAVO CORP.*—Robert Hughes, director of research and development.

Your ideas work better when you work with HONEYWELL

The following pages bring you the latest developments in automatic controls from Honeywell. They widen your choice of products, give you more to work with.

For complete information on these new control products and systems, call your nearest Honeywell sales office. Honeywell provides 112 offices throughout the country; each is staffed with capable control specialists to assist you in preparing proposals and writing specifications.

Look over these new products and systems. And, remember, they are backed by the kind of support only Honeywell can offer you.

FOR MORE TO WORK WITH ... WORK WITH HONEYWELL

WHO'S WHAT

Continued

▶ *IRON FIREMAN MFG. CO.*—William B. Gibson, heating controls manager.

▶ *WORTHINGTON CORP.*—Walter A. Penner, district office manager of Denver district office.

▶ *BARNEBEY-CHENEY CO.*—R. L. Trout, "PurAir" sales manager; Frank R. Schwartz, Jr., research director.

▶ *NATIONAL INDUSTRIAL SERVICE ASSOCIATION, INC.*—Arthur Cecil Roe, consulting engineer.

▶ *NATIONAL-U. S. RADIATOR CORP.*—Robert S. Hall, manager of personnel and industrial relations.

▶ *ROCKWELL MFG. CO.*—Howard J. Evans, manager of engineering and research for all gas products.

▶ *TACO HEATERS INC.*—Alton P. Dieffenbach, manager product planning; Peter L. Quattrochi, manager of customer services.

▶ *F. E. MYERS & BRO. CO.*—Dick Topper, advertising and sales promotion manager; Bill Cooper, public relations manager.

▶ *ALLIED CONTROL CO., INC.*—Edward Bachorik, general sales manager.

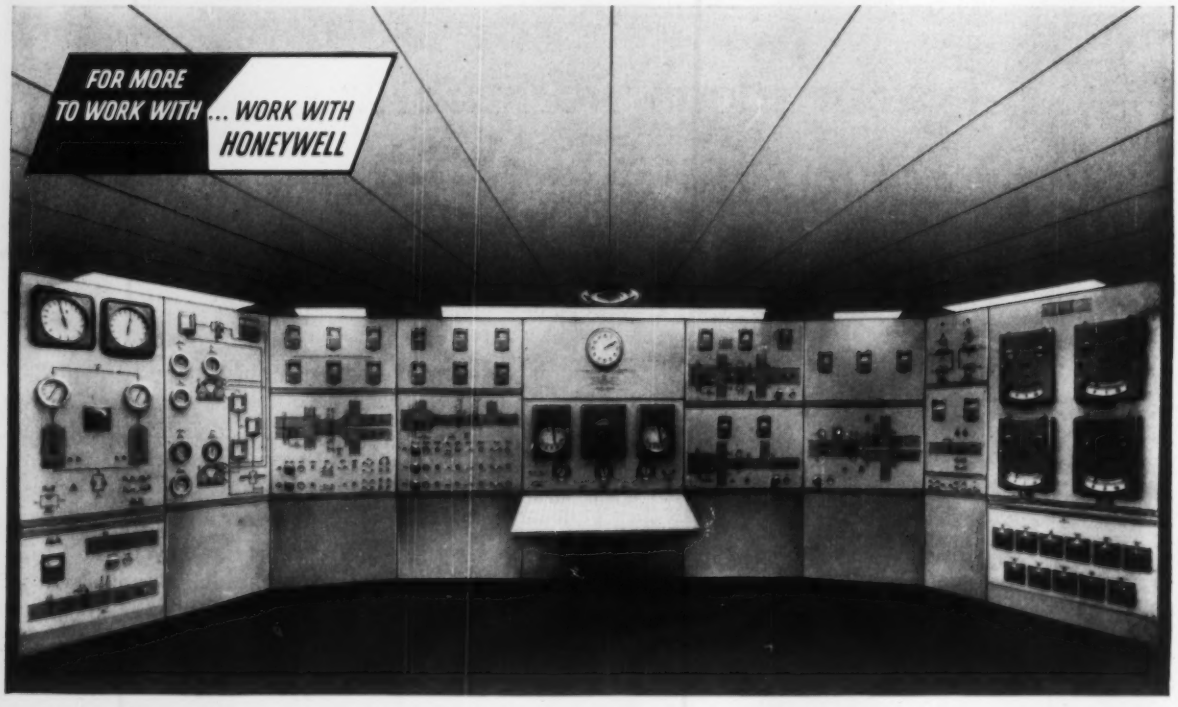
▶ *CARRIER CORP.*—Gordon V. Bond, specialist for "Weathermaster" air conditioning systems for the company's machinery and systems division.

▶ *LAU BLOWER CO.*—Richard F. Mahuron, general manager of company's western division plant in Ilwindale, Calif.

▶ *PAYNE CO.*—Orrin E. Burwell, managing director of product application and engineering department.

▶ *WHIRLPOOL CORP.*—L. M. Larkin, general manager of air conditioning division, elected vice chairman of Room Air Conditioning Section, National Electrical Manufacturers Association.

▶ *DAYTON RUBBER CO.*—Maj. Gen. Gerald J. Higgins, assistant to the president on military matters.



Honeywell Supervisory DataCenter in Reynolds Metals Office Building, Richmond, Va., controls all ten of the air conditioning systems in the building.

Architect: Skidmore, Owings and Merrill; Project and Construction Managers: Ebasco Services Incorporated; General Contractor: George A. Fuller Company; Mechanical Contractor: Huffman-Wolfe Southern Corp.; Electrical Contractor: E. C. Ernst, Incorporated.

WHO'S WHAT

Continued

▶ *AMERICAN STANDARDS ASSOCIATION*—Robert H. Swoyer, Sr., mechanical engineering department of Pennsylvania Power and Light Co., Allentown, elected chairman of sectional committee concerned with fundamentals of performance of effluent air and gas cleaning equipment.

▶ *SOUTHERN UNION GAS CO.*—W. F. Wright, Jr., utilization manager.

▶ *BETTER HEATING-COOLING COUNCIL*—Keith D. Clotz, sales estimating engineer with Spohn Heating & Ventilating Co., elected president.

▶ *AMERICAN GAS ASSOCIATION*—J. Theodore Wolfe, president of Baltimore Gas and Electric Co., elected president.

▶ *CHRYSLER CORP., AIRTEMP DIV.*—Frederick J. Laughna, director of branch operations; J. B. Ogden, vice president—sales, reelected chairman of Room Air Conditioning Section, National Electrical Manufacturers Association.

▶ *AMERICAN AIR FILTER CO., INC.*—Charles S. Stock, manager of unit ventilator products department, elected to executive committee of Producer's Council, Inc.

▶ *GENERAL ELECTRIC CO.*—John R. Casey, manager of user industries sales for New England.

▶ *ROBERTSHAW-FULTON CONTROLS CO.*—superintendent of *BRIDGEPORT THERMOSTAT DIV.*

▶ *TRANE CO.*—Arthur W. McClure, senior development engineer.

▶ *KEASBEY & MATTISON CO.*—Daniel F. Altemus, manager of department of investigation, standardization and improvement; Yock Lio Lim, junior development engineer.

▶ *JOSEPH T. RYERSON & SON, INC.*—C. Nelson Wetherell, manager of systems and procedures division.

▶ *EUTECTIC WELDING ALLOYS CORP.*—Rene D. Wasserman, welding industry chairman of the United States Committee for the United Nations.

*Honeywell Supervisory DataCenter**

supervises and controls 10 air conditioning systems in new Reynolds Metals Building!

The Honeywell Supervisory DataCenter shown on the facing page is installed on an aluminum panel in a special control room at the new Reynolds Metals Company Office Building in Richmond, Virginia.

From this central location the building engineer has complete supervision and control of the critical temperatures in the building's 10 air conditioning systems. The DataCenter supervises the heating plant, refrigeration system, exhaust air systems and some 79 critical space temperatures throughout the building.

In this Reynolds Metals Building, as in the 350† other Honeywell Supervisory DataCenter installations throughout the country, the controls, instruments and central panel were all manufactured, installed and guaranteed by Honeywell—benefits that only Honeywell can offer.

These 350 DataCenters now operating in all types and sizes of buildings clearly demonstrate Honeywell's leadership in centralized control. And this experience is available to you at no obligation. A Honeywell control specialist will be happy to work with you in designing a center to fit your client's needs. Just call your local Honeywell office. *Trademark

†*List of installations, including those in your area, available on request.*

Honeywell

First in Control

WHO'S WHAT — *Continued*

▸ *COLT VENTILATION OF AMERICA, INC.*—Jack Janofsky, technical consultant.

▸ *NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION*—Officers of General Engineering Committee of the Room Air Conditioning Section are: William G. Spiegelhalter, engineering manager, product design—room air conditioning, General Electric Co., chairman; Robert H. Meyerhans, director of engineering, Fedders-Quigan Co., vice chairman.

IN THE TERRITORIES . . .

(Recent sales appointments)

▸ *SPORLAN VALVE CO.*—Harold S. Jordan, manager of Kansas City office; Tom Enos, representative in Los Angeles office.

▸ *TUCK-AIRE FURNACE CO.*—Irvington Sales, Inc., Buffalo, N. Y., manufacturer's representative.

▸ *THERMOWHEEL, INC.*—E. M. Tarnoff Co., Norwalk, Conn., lower New York State, Maine, Massachusetts, Vermont, Rhode Island, Connecticut; Fred T. Pike Co., Rochester, N.Y., upper and western New York; Bessam Engineering, Cleveland, Cleveland and northern Ohio; Hesco Corp., Cincinnati, south Ohio; northern Kentucky, southern Indiana; D. J. Guerin Co., Chicago, northern Illinois and southern Wisconsin; Atech Supply Co., Toledo lower Michigan, northern Indiana, northwestern Ohio; DeHaas & Mitchell, Grand Rapids, Mich., western and northern Michigan; R. B. Davis Co., Ardmore, Pa., eastern Pennsylvania, Delaware, southern New Jersey; all authorized representatives.

▸ *RELIANCE ELECTRIC & ENGINEERING CO.*—James H. Chambers, sales engineer in Atlanta sales office; Richard A. Christman, sales engineer in Cincinnati sales office; Melvin H. Hare Greenville, S.C., sales engineer; Merle M. Morrow, St. Louis sales engineer; Millard H. Phelps, San Francisco, sales engineer.

▸ *DUNHAM-BUSH, INC.*—J. B. Fairchild, sales engineer in Los Angeles; Hans Bren, application engineer for Los Angeles office; George Klahn, San Diego sales representative.

FOR MORE TO WORK WITH ... WORK WITH HONEYWELL

For your mechanical systems...Honeywell Hi Velocity Double-Duct Mixing Box Controls

Now your choice of two constant volume systems

1. Honeywell's Volumatic* system gives clients dependable, economical, constant volume control of double-duct systems. This control system uses piston motors with nylon bearings which require less lubrication and a sensitive pressure regulator. It can be applied to all sizes and types of mixing boxes.
2. Honeywell's Duablend* system gives your clients superior performance and minimum maintenance. Better performance is secured by using *two* pressure regulators to assure constant volume from *each* duct (under control of space thermostat) regardless of pressure changes. Its exclusive Sub-master pressure regulator provides a similar stabilizing control action to the Sub-master duct thermostat in heating and ventilating units.

For minimum maintenance, the Duablend† system uses the simple Honeywell Air-Balance Valves*. These valves have no mechanical parts to wear and no adjustments. The valves operate on the balance of air pressure on two sides of a flexible diaphragm.

*Trademark
†Duablend formerly termed Air Blender

Honeywell First in Control

WHO'S WHAT

Continued

▸ *DRAYER-HANSON, DIV. of NATIONAL-U. S. RADIATOR CORP.*—Mechanical Equipment Co., Salt Lake City, sales agent for Utah, southern Idaho, southwestern Wyoming and northern Nevada; Authorized Supply Corp., Los Angeles, exclusive sales agent in Los Angeles area and Arizona.

▸ *INDUSTRIAL ACOUSTICS CO., INC.*—Manufacturing representatives: Dan B. Billington, Cleveland; Jack Chichester, Mobile, Ala.; Empire State Equipment Co., Providence, R. I.; Houston Co., Lubbock, Tex.; Airadyne Co., West Roxbury, Mass.

▸ *POWERS REGULATOR CO.*—G. J. Kraai, Kansas City, Mo., branch manager; E. Wayne Dickinson, Des Moines branch manager; John T. Lynam, Pittsburgh branch manager.

▸ *WOLVERINE TUBE DIV. of CALUMET & HECLA, INC.*—Robert Allan, sales representative in Detroit area; S. C. Seekell sales representative in Grand Rapids and western Michigan.

▸ *PAYNE CO.*—Don Driver, sales engineering representative in southern California area.

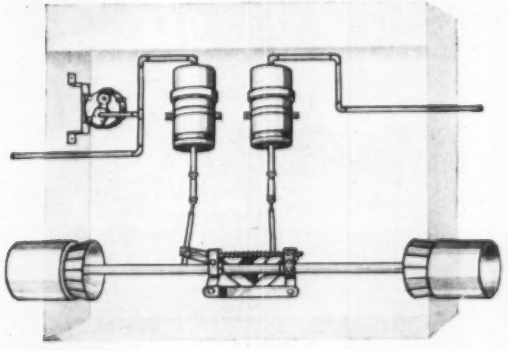
▸ *AMERICAN AIR FILTER CO., INC.*—Glenn M. DeBaker, sales engineer, Milwaukee branch sales office.

▸ *JOY MFG. CO.*—Boston branch office moved to Second Ave., Burlington, Mass.

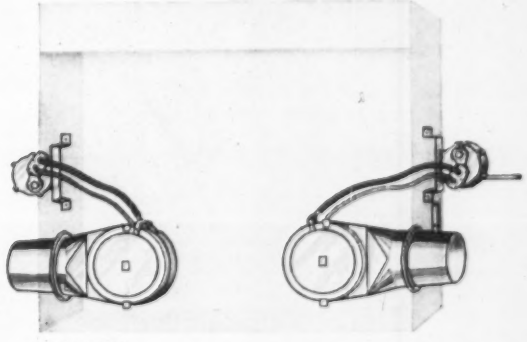
▸ *ORR & SEMBOWER, INC.*—New sales and service representatives: Enterprise Heat & Power Co., Chicago; Barnhart-Dwyer Co., Albuquerque; Cone & Wallace Co., Phoenix; Robert B. Stockdale Associates, Houston; Todd Machinery Co., Salt Lake City.

▸ *MARLO COIL CO.*—McLaughlin and Co., San Francisco, sales representative in northern California and northwestern Nevada; H. T. Allen, appointed to staff of Engineering Sales Co., Jackson, Miss., representative.

▸ *TENNEY ENGINEERING, INC.*—Harold Sweeney, representative in Maryland, Washington, D. C., Virginia, West Virginia, Kentucky, Pennsylvania and southern Kentucky.



VOLUMATIC



DUABLEND

Here's how these two dependable systems work

Volumatic System: 1) Space thermostat operates motor to change ratio of hot and cold air. 2) Pressure regulator in mixed air operates another motor to adjust linkage, increase or decrease total volume from both hot and cold ducts (as shown above). Or, (not shown) 1) Space thermostat operates motor to control hot duct valve. 2) Pressure regulator in mixed air operates motor to control cold duct valve, maintain constant total volume. This low cost system gives dependable control, is easy to maintain, fits all sizes and types of mixing boxes.

Duablend System: 1) Space thermostat resets Sub-master pressure regulator controlling valve in hot duct. 2) Pressure regulator in mixed air controls the total air volume by operating cold duct valve. 3) Change in flow resulting from changes in hot duct pressure is corrected by Sub-master regulator operating hot valve without disturbing cold. 4) A change in flow caused by changes in cold duct pressure is corrected by regulator controlling total flow which adjusts cold duct valve. Sub-master flow regulator holds hot duct flow constant.

WHO'S WHAT

Continued

▸ *AXEMAN-ANDERSON CO.*—John C. Preston, New England representative.

▸ *SPORLAN VALVE CO.*—W. A. Reichenbach, district manager for New York and New England territories.

▸ *UNITED STATES AIR CONDITIONING CORP.*—J. W. Cherry, sales representative in Louisiana.

▸ *K S M PRODUCTS, INC.*—John T. Rayner, regional sales manager for the Pacific area; F. Leonard Hultquist, sales engineer in Los Angeles area.

▸ *MINNEAPOLIS-HONEYWELL REGULATOR CO.*—Hugh MacNair, central region commercial sales manager with offices in Cleveland; Harold Fox, Pacific region service and installation manager, Los Angeles; John R. Green, southeast region service and installation manager, Atlanta; Allan R. Lesslauer, New Jersey branch commercial sales manager; Lin L. Grisham, Indianapolis branch service and installation manager; Rudolf Saliwanchik, service and installation manager in St. Louis branch.

▸ *A. M. BYERS CO.*—Calvin L. Wright, Baltimore field service engineer; Robert B. McQuarrie northwest coast field service manager.

▸ *PROCESS EQUIPMENT DIV. of ADVANCE INDUSTRIES, INC.*—New sales representatives and their territories: Air & Hydraulic Equipment Co., Minneapolis, state of Minnesota; J. Arthur Moore Co., New York, metropolitan New York; Nielsen & Fryer, Inc., Chicago, northern Illinois, northern Indiana, eastern Wisconsin, eastern Iowa; Eugene F. Zeiner & Co., Narberth, Pa., Philadelphia and Wilmington, Del., Service Equipment Electronics, Inc., Cleveland, Ohio and southern Michigan; Gay Sales Co., Inc., Houston, Texas and Louisiana.

▸ *BINKS MFG. CO.*—Export facilities and factory branch moved to 35-42 41st St., Long Island City 1, N.Y.

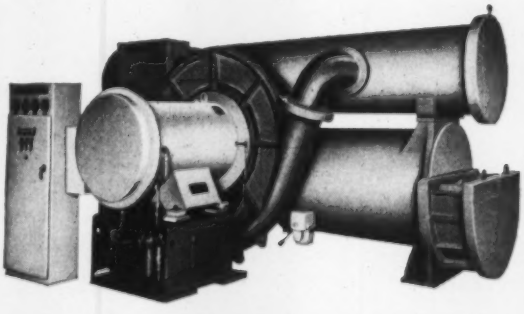
▸ *AMERICAN AIR FILTER CO., INC.*—R. J. Clark Equipment Co., Inc., Clearwater, Fla., sales representative; Raymond J. Dunn, Shreveport, La., representative; Don Ryan, Tom Mulvey and Larry Harlen, sales engineers, Chicago; Edward A. Cruse, sales engineer, Detroit; Harold Bee, representative with the Rush Co., Kansas City.

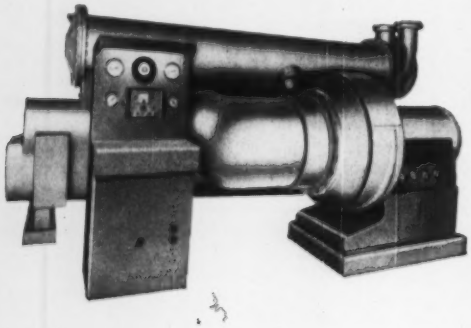
FOR MORE TO WORK WITH ... WORK WITH HONEYWELL

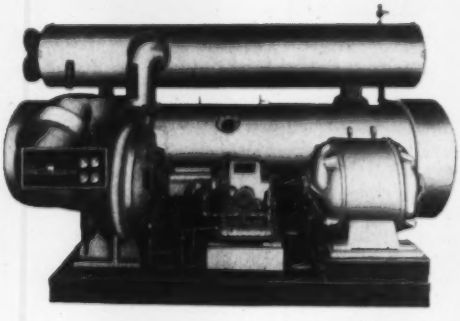
Honeywell Electronic correction of centrifugal

Leading manufacturers use Honeywell controls

Note the free selection of panel location permitted by these Honeywell electronic controls as they are used by leading manufacturers. They hold the chilled water in these machines within plus or minus 1½°—often within plus or minus ½°. The system does not require a wide throttling range, therefore there is little offset from the control point. The motor load limiting system on these controls provides instantaneous correction of vane position.







WHO'S WHAT

Continued

▸ *GOLDEN-ANDERSON VALVE SPECIALTY CO.*—Stolley & Orlebeke, Chicago representative.

▸ *SWARTWOUT CO.*—Air Products Equipment Co., Chicago sales representative; Leonard F. Luchner Co., Boston sales representative.

▸ *TURNER BRASS WORKS*—Louis White, salesman, Philadelphia, Washington, D. C., and Baltimore areas; John Cloonan, salesman in New England area.

▸ *TYPHOON AIR CONDITIONING CO.*—Albert F. Johnson, district sales manager southern Florida, also representing *TYPHOON HEAT PUMP CO.*

▸ *COCHRANE CORP.*—Boiler Equipment Service Co., Atlanta, moved to 1079 Alco St., N. E., in that city.

▸ *DEMING CO.*—Glenn Hoke, salesman, Michigan territory.

▸ *AUTOMATIC SWITCH CO.*—E. Keeler Co., Williamsport, Pa., authorized stocking distributor.

▸ *FARR CO.*—Air Filter & Service, Sacramento, representative for northern California and Nevada; R. H. Sparks, Des Moines, representative for Iowa, Nebraska and Rock Island County, Illinois; Air Filter & Sales Service, Kansas City, Mo., representative for Kansas and western Missouri; R. N. Toucey, Pittsburgh, representative for Pennsylvania; Industrial Supply Co., Syracuse, representative for New York.

▸ *AIR REDUCTION SALES CO.*—Fred T. Wilson, Jr., manager of New Orleans sales office; E. C. Kennedy, assistant manager, sales, New Orleans.

▸ *U. S. GAUGE DIV. of AMERICAN MACHINE AND METALS, INC.*—Whitson Engineering Co., distributor.

▸ *WARREN PUMPS, INC.*—Edward H. Elliott, industrial sales representative in Philadelphia area.

▸ *CHASE BRASS & COPPER CO.*—Frank J. Anderson, district manager of Seattle office.

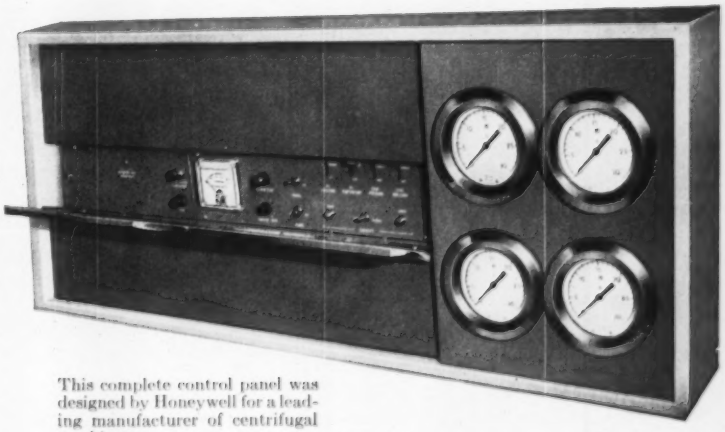
▸ *MAXITROL CO.*—Charles T. Burklow, representative in southeastern United States. ≠

Controls give accurate sensing, rapid refrigerating machines

This Honeywell Electronic Control System combines the functions of chilled water temperature control and motor load control. Its application to centrifugal refrigeration offers your clients these important advantages:

- Rapid, accurate control of chilled water temperature; instant, positive correction.
- Maximum input current can be set at any predetermined value by a simple adjustment of the load limiting switch.
- The simplest, most trouble-free control of temperature and motor current.
- Consolidates all equipment in one location, permits setup, adjustment and service from the central panel, keeps adjustments secure in a tamper-proof enclosure.
- Permits free selection of panel location—troublesome capillaries are eliminated.

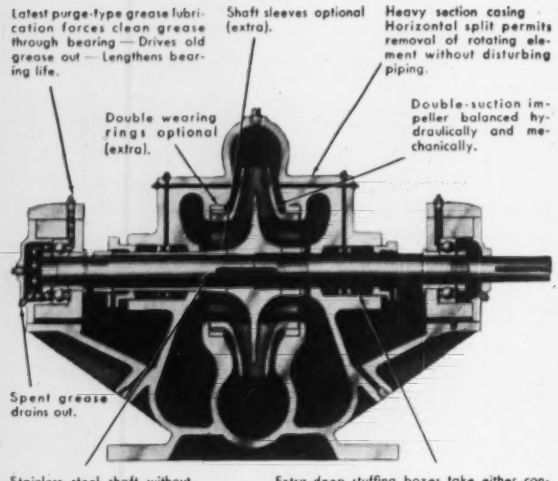
For further information call your nearest Honeywell office. Or write Minneapolis-Honeywell, Department AC-11-103, Minneapolis 8, Minnesota.



This complete control panel was designed by Honeywell for a leading manufacturer of centrifugal machines.

Honeywell

H First in Control

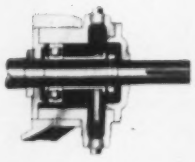

Latest purge-type grease lubrication forces clean grease through bearing — Drives old grease out — Lengthens bearing life.
Shaft sleeves optional (extra).
Heavy section casing Horizontal split permits removal of rotating element without disturbing piping.
Double wearing rings optional (extra).
Double-suction impeller balanced hydraulically and mechanically.
Spent grease drains out.
Stainless steel shaft without sleeves is standard.
Extra-deep stuffing boxes take either conventional packing or mechanical seals.

New Purge-type Grease Lubrication

CUTS PUMPING COSTS

on American-Marsh Type HLM and HIM Split Case Centrifugals

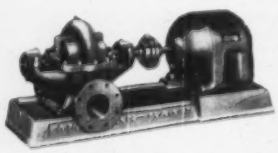
What does Purge-type Grease Lubrication offer you? Just this: By pushing out spent or dirty grease every time bearing is lubricated, it adds years of extra bearing service. That means less maintenance and longer pumping service from your total investment.



Ring-oiling ball bearings are also available (optional).

Many other superbly engineered features combine to eliminate interruptions and cut costs for A-M owners. Study the drawing a moment — You'll notice extra deep stuffing boxes and other details that are better designed, better built than ordinary pumps.

Then write for new HLM-HIM Bulletin 350, with full details and performance data.



HLM and HIM pumps are famous for low-cost service.

Pumps and Pumps only Since 1873

AMERICAN-MARSH PUMPS

BATTLE CREEK MICHIGAN

Representatives in all principal cities. See our ads in C.E.C., ASME Catalogs

CENTRIFUGAL, TURBINE, STEAM AND POWER PUMPS FOR TESTING, PROCESSING, BOILER FEED, FIRE PROTECTION, ETC

WE HEAR THAT...

▸ *NATIONAL-U. S. RADIATOR CORP.* dedicated its new 40,000 sq ft, million dollar engineering center at Johnstown, Pa. last month. Dr. Eric A. Walker, president of Pennsylvania State University, was the principal speaker. Guests included nearly 100 leaders in the heating and air conditioning industry.

▸ *SPORLAN VALVE CO.* has announced a new organizational structure for its field sales offices. The new setup groups the company's 17 sales offices into nine geographical sales districts.

▸ *K S M PRODUCTS, INC.* has established a new warehouse and sales office at 656 Folsom St., San Francisco. In addition to maintaining new equipment, parts and welding studs, the office will supervise and service stud welding accounts for the northern Pacific Coast area.

▸ *HORACE T. POTTS CO.* has just awarded a four year scholarship in industrial distribution at Temple University to a Pennsylvania high school graduate.

▸ Russell E. Anderson, Norman Snow and Ray Rutkowski have announced the formation of *ANDERSON-SNOW CORP.* for the manufacture of standard as well as custom built coils for special applications. The new line will include heating coils, cooling coils and air handling equipment for use in heating, ventilating and air conditioning systems. The plant is located at 3863 N. Milwaukee Ave., Chicago 41.

▸ One of the two plants of *MARVEL-SCHEBLER PRODUCTS DIV. of BORG-WARNER CORP.* at Decatur, Ill. is being converted to the manufacture of air conditioning and refrigeration equipment. The plant now has become part of the corporation's *YORK DIV.* A new line of room air-conditioners with cooling capacity ranging from 6000 to 17,500 Btu per will initially be produced at the plant.

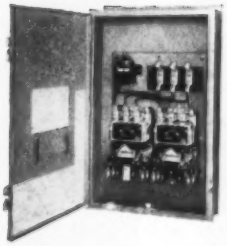
▸ *HUDIK-ROSS, INC.* has just opened a new two story, air conditioned plant in Hackensack, N. J. Steamfitting, refrigeration, service and engineering divisions will be maintained in the new building, as well as a complete sheet metal and fabrication shop.

▸ *PEERLESS HEATER CO.* has just added a new testing section to their recently completed engineering and research laboratory at Boyertown, Pa. The new section provides facilities to keep boilers under constant observation under the most severe conditions.

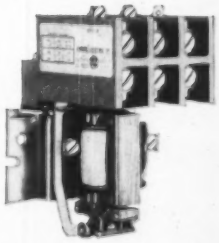
FURNAS ELECTRIC

CONTROLS HELP YOU REDUCE COST AND SPACE REQUIREMENTS

Magnetic Starters in 10 sizes to 100 hp. Furnas starters for control of high horsepower compressors offer the exclusive Furnas "in-between" size starters with dual voltage magnet coils.



Step or Cushion Starting permits the use of larger motors by limiting the inrush current on starting. These methods reduce or completely eliminate objectionable line disturbances due to full voltage across-the-line starting. Furnas Electric offers a complete line of Increment, Auto Transformer and Resistance-type Step Starters.



Furnas contactors feature 20, 24, 30, 35, 40, and 50 ampere sizes to match starter requirements. Silver cadmium oxide contacts for longer life. Floating armature insures quiet operation.

For full information write for Bulletin 5610, 1041 McKee St., Batavia, Ill.

A42

FURNAS ELECTRIC COMPANY

BATAVIA, ILLINOIS

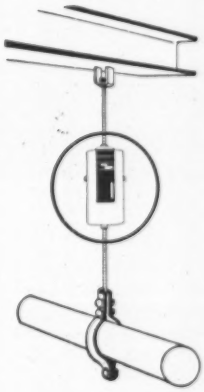
SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

"WITCH"

PIPE HANGERS

FOR

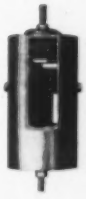
HEATING – PLUMBING POWER & PROCESS



- Rugged
- Compact
- Simple in design and installation
- Indispensable for systems operating at changing temperatures

FIG. 401

SPRING HANGER



Our catalogue illustrates a complete line of Pipe Hangers & Supports and is an indispensable reference book for engineers, contractors, estimators & erectors. Write for your copy now.

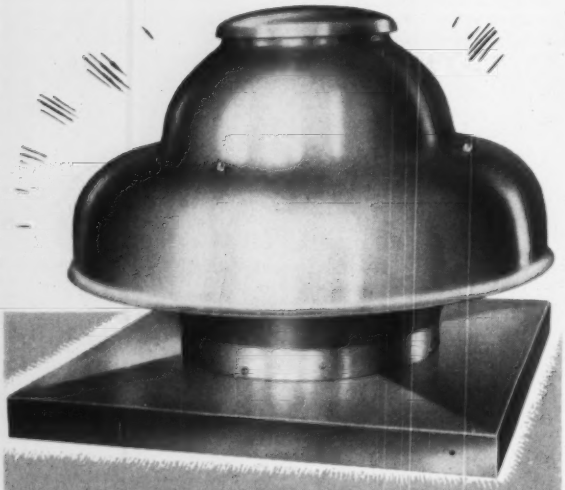
MAINTAINING OFFICES AND WAREHOUSES ACROSS THE NATION

CARPENTER and PATERSON, Inc.

18 HURLEY ST., CAMBRIDGE, MASS.

Aladdin
AIR HANDLING EQUIPMENT

Type "S" *Centrifugal*
ROOF VENTILATORS



- CERTIFIED RATINGS
- ALUMINUM HOUSED
- ATTRACTIVE DESIGN
- WEATHERPROOF
- QUIET OPERATION

ALADDIN Type "S" Roof Ventilators feature an attractive Spun Aluminum Housing of low contour. Designed especially for those installations which require a small powered exhaust unit. The Type "S" Roof Ventilator is ideally suited for schools, hospitals and similar type buildings.

Seldom requiring maintenance, these units are furnished with unusually quiet, fan cooled motors with outstanding lubricating systems, assuring long, continuous service under severe conditions of dust and dirt.

Write for complete data

ALADDIN HEATING CORPORATION
1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

WE HEAR THAT — *Continued*

▸ *METALS & CONTROLS CORP.* has centered all Klixon Thermostat production, engineering and sales for commercial applications at its *VERSAILLES PRODUCTS DIV.*, Versailles, Ky.

▸ On September 24 *WORTHINGTON CORP.* adopted a new trademark, replacing their 73 year old winged emblem, as part of an overall modernization campaign.

▸ *BEACH-RUSS CO.* moved its general sales office to larger quarters in the Graybar Building at 420 Lexington Ave., New York 17, on October 1.

▸ Construction of the new second addition to the Faribault plant of *McQUAY, INC.* will start immediately. The company also has begun the improvement of manufacturing facilities at Grenada, Miss. plant.

▸ *JOHNS-MANVILLE CORP.* has proposed a merger with *L.O.F GLASS FIBERS CO.* on the basis of one share of its common stock for two and one-half shares of the glass company's common stock.

for

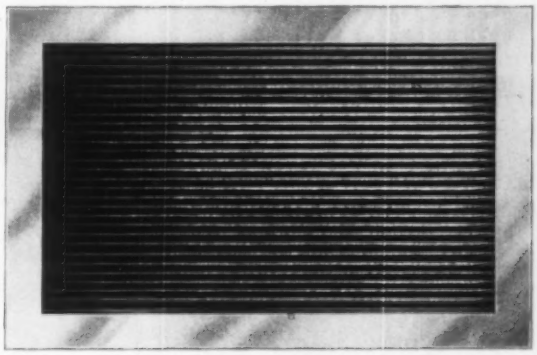
SPECIFICATION *and* BUYING INFORMATION

Use your complete, up-to-date

JANUARY DIRECTORY ISSUE

Your job will be a lot easier if you'll keep the January Directory issue of Heating, Piping & Air Conditioning available for handy reference. It's one of your most valuable tools — one which will save you many hours of looking up the products you need for your various jobs. It's the ONE complete, up-to-date, readily accessible source of product information on who makes the blowers, traps, boilers, fittings, specialties of all kinds, etc., you need — and where they're located. They're identified by trade names, too. EVERY product is listed, alphabetically arranged and printed on a distinctive yellow stock for easy reading and reference. Keep it handy . . . it's a time saver.

NEW FROM A-J
NO-VISION GRILLE
ALL ALUMINUM



A-7000-B GRILLE

Another first in the field for A-J! New, extruded aluminum A-7000 grille offers exclusive quality features never before available:

Corrosion resistant and rust free.

Minimum weight.

Maximum free area—approximatey 70%.

Easily installed in minimum amount of time.

The entire unit reflects quality in every construction detail. By utilizing an auxiliary frame the grille span can be adjusted from $1\frac{1}{4}$" to $2\frac{1}{8}$" depth.

Mill finish is standard unless otherwise specified. Anodized or polished finishes available.

Please write for free catalog.

See our file in SWEET'S — 30f/Aa

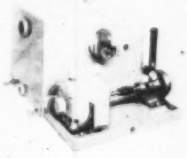
A-J MANUFACTURING CO.

3601 E. 18th St. **Dept. H-11** **Kansas City 27, Mo.**

EAGAN...

the complete line of Condensate Return Pumps

Eagan offers a full line of Condensate Return Pumps, and also manufactures Fuel Oil Pump and Heater Sets, Proportioning Pumps, Turbine Pumps and Centrifugal Pumps.

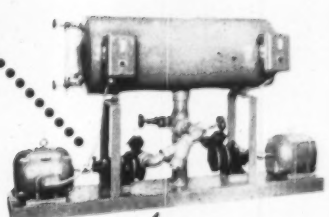


EAGAN EAGLE —For steam heating loads up to 8000 sq. ft. at 20 p.s.i. Does not require pit even though return lines are no more than one foot above the floor.

EAGAN HOT POT —Vertical submerged type pump with cast iron receiver. Motor and pump above receiver safe from flooding. Single and duplex construction. Models for loads up to 15,000 sq. ft. at 20 p.s.i.

TYPE ECIV —Vertical pump and receiver for installations where return lines are below floor levels. Single or duplex units. Models up to 10,000 sq. ft. capacity at 60 p.s.i.

TYPE EC —Straight line arrangement requiring less floor space than necessary for competitive makes. Both pumps accessible for maintenance purposes. Single and duplex models designed for 2000 to 100,000 sq. ft. discharging against pressures of from 10 to 200 p.s.i.



WALTER H. EAGAN CO., INC.

Pump Specialists Since 1920

2336 Fairmount Ave., Dept. HPAC, Phila. 30, Pa.

Gentlemen:

Send me complete information on the EAGAN Line of Condensate Pumps.

COMPANY .....

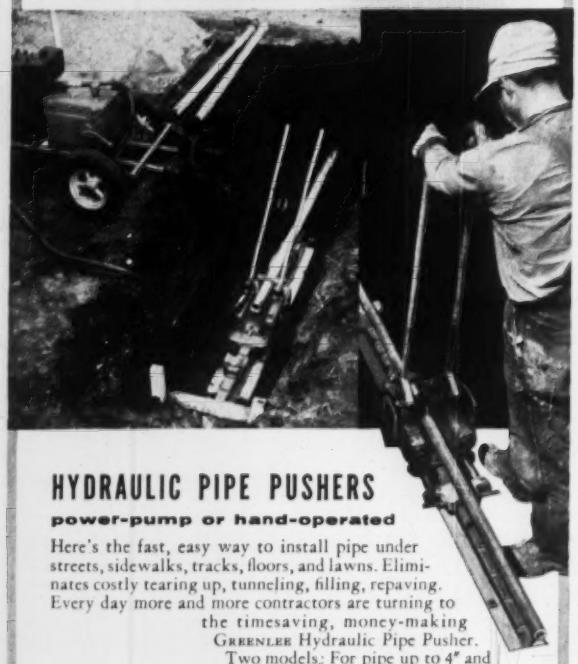
NAME .....

ADDRESS .....

CITY ..... ZONE .. STATE .....

CUT COSTS, SPEED JOBS

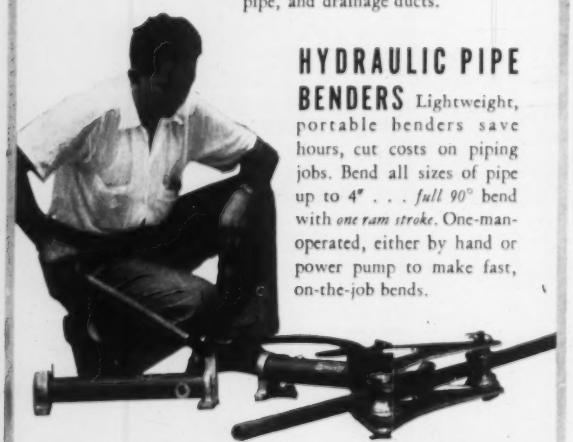
with timesaving Greenlee tools



HYDRAULIC PIPE PUSHERS

power-pump or hand-operated

Here's the fast, easy way to install pipe under streets, sidewalks, tracks, floors, and lawns. Eliminates costly tearing up, tunneling, filling, repaving. Every day more and more contractors are turning to the timesaving, money-making GREENLEE Hydraulic Pipe Pusher. Two models: For pipe up to 4" and for larger size pipe, concrete sewer pipe, and drainage ducts.



HYDRAULIC PIPE BENDERS Lightweight, portable benders save hours, cut costs on piping jobs. Bend all sizes of pipe up to 4" . . . *full* 90° bend with *one ram stroke*. One-man-operated, either by hand or power pump to make fast, on-the-job bends.

PLUMBERS' PIPE BIT SET

For fast, accurate boring of holes in wood for ½" through 2" pipe. Designed for use in portable electric drills. Adapter also provided for use of bits with auger bit brace.

HEXAGON-SHANK POWER BITS

True-boring ship augers with hexagon shank for positive, nonslip drive. Fit ¼" and larger chucks and ½" round sockets. Choice of points and twists. Wide size range.

GREENLEE

GREENLEE TOOL CO.
2351 Twelfth Street
Rockford, Illinois

WE HEAR THAT

Continued

▸ The new plant of the *UNITED STATES GAUGE DIV. of AMERICAN MACHINE AND METALS, INC.* in Sellersville, Pa., was open for plant tours two days of last month.

▸ *RANCO INC.* has opened a new research center at Pompano Beach, Fla. The new center provides space and facilities for the present staff and operations as well as space for planned future expansion.

▸ *OVERHEAD HEATERS, INC.* is sponsoring a "Field Installation Clinic" program for the benefit of jobber-dealer and installing contractor groups, architect-engineer associations and construction personnel of retail chain organizations.

▸ On September 9, *BELL & GOSSETT CO.* started a series of regional educational meetings intended especially for architects and engineers. The meetings have been planned around a new design manual, "Zone Control with the Bell & Gossett System of Primary and Secondary Pumping." Meetings have been scheduled for major cities throughout the United States.

▸ *THERMAL SUPPLY INC.* has acquired the assets of *UNITED SUPPLY*, San Antonio, Tex., as well as its branches in Austin, Corpus Christi, Harlingen, McAllen and Victoria, Tex.

▸ *PEERLESS HEATER CO.* has just added a new testing section to their recently completed engineering and research laboratory for testing the company's boilers under the most severe conditions.

▸ *ELGEN MFG. CORP.* has leased a building at 39-42 Gale Ave., Long Island City, N. Y. Besides ample manufacturing facilities, the building offers extensive storage, shipping space and experimental-research areas.

▸ Completion of an 8000 sq ft addition scheduled for December will double the manufacturing space of *JAMESBURY CORP.*

▸ *KEASBEY & MATTISON CO.* has announced that work has begun on its major building program in Ambler, Pa. The program includes a new office building as well as a modern research and development center which should be completed by midsummer, 1959.

(*Continued on page* 281)

proved by controlled laboratory test

stronger than standard or extra strength clay pipe

Just how permanent is a Therm-O-Tile installation may be gauged from Therm-O-Tile's strength. For Therm-O-Tile is **extra** strong — actually stronger than extra strength clay pipe! Substantiating this claim are the results of exacting tests conducted under rigid laboratory conditions by an independent testing laboratory. Write for complete strength-test data.

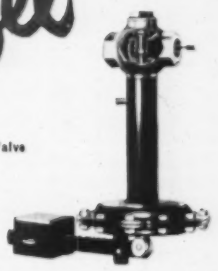
Therm-O-Tile conduit system

FOR UNDERGROUND PIPING

H. W. PORTER CO., INC. — NEWARK 12, NEW JERSEY
or Subsidiary
REID HAYDEN, INC.—BALTIMORE • CHARLOTTE • RICHMOND

If you need to reduce fluid pressure safely, economically... call for a valve from

Klipfel

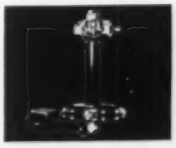


No. 310 Reducing Valve

Klipfel makes Reducing Valves for every purpose — 60 different types of them, in fact. They operate on air, gas, steam, water or other liquid, with initial pressures up to 300 psi and reduced pressures as low as vacuum. You can choose from five different inner valves, three different actuating means and four loading means.

Also available from Klipfel are Float Valves, Relief Valves and Temperature Regulator Valves and special valves made of corrosion-resistant materials. For information on any valve, call your supply house or write for Catalog 54.

Call your supply house, or write for Catalog 54.



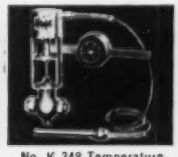
No. 410 Reducing Valve

No. 300 Reducing Valve

AIR MAIL

Most items shipped within 24 hours after order is received

No. K-449 Temperature Regulator Valve

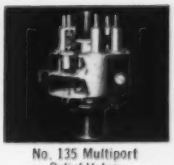


No. K-348 Temperature Regulator Valve

No. 135 Relief Valve

No. 7 Float Valve

No. 27 Float Valve



No. 135 Multiport Relief Valve

HAMILTON • OHIO **Klipfel** VALVES INC.

Automatic Temperature-and-Pressure-Regulating Valves Since 1902

Float Valves • Temperature Regulators • Back Pressure Valves • Reducing Valves

A DIVISION OF THE HAMILTON-THOMAS CORPORATION

GET COMPLETE FACTS
NOW ON HOW THESE

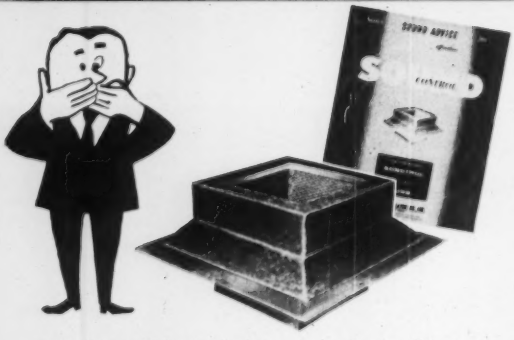
SILENT PARTNERS
CAN BEST ANSWER *YOUR* VENTILATION NEEDS

DOMEX ROOF EXHAUSTER*.

Domexes feature "direct discharge" design in addition to the deep one piece spun "Significant Scroll" inlet that provides quiet operation. Full details are contained in the new 12-page Bulletin DMXA-88 available immediately upon request.

**specified recently for Reynolds Metals Co., Massena, N. Y.*

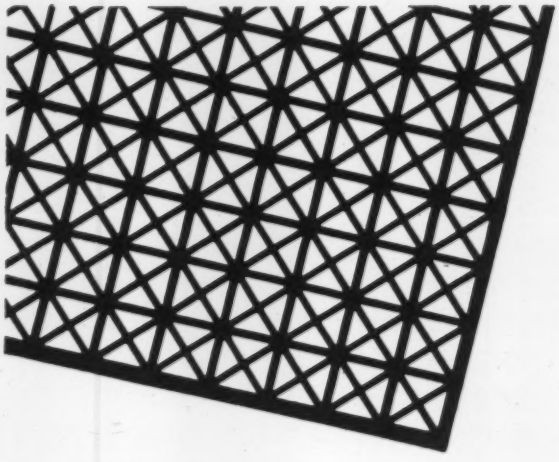
SONOTROL CURB
...FOR SOUND CONTROL



. . . a factory fabricated roof curb combining structural stability and sound attenuating qualities definitely superior to field-constructed curbs. The Sonotrol is priced competitively with on-the-job constructed curbs; it also defines and stabilizes dimensions. It is an excellent companion piece for all motor driven exhausters.

The Penn Ventilator Man in your area has complete details. Contact him for a copy of Bulletin SC-88 containing complete information.

PENN VENTILATOR CO. Inc.
PHILADELPHIA 40, PENNA.
Representatives and Distributors in Principal Cities
Charter Member of AMCA



THEY'RE ELEGANT ...THEY'RE ECONOMICAL

Hendrick Architectural Grilles

When an architect draws up specifications for a new building or a modernization proposal he must adhere to two basic principles: FIRST, he must use his head in keeping costs down. SECOND, he must recommend functional materials and components that appeal to his client's decorative motif and sense of beauty. That's why more and more architects specify Hendrick Grilles. Available in hundreds of attractive designs, Hendrick Grilles cost less to buy . . . cost less to install and cost less to maintain! And they provide more-than-ample area for free passage of air . . . always lie flat . . . don't bend or warp. For more information write to Hendrick, today.

HENDRICK
MANUFACTURING COMPANY
48 DUNDAFF STREET **CARBONDALE, PA.**

Perforated Metal • Perforated Metal Screens • Wedge-Slot Screens • Hendrick Wedge Wire Screens • Architectural Grilles Mitco Open Steel Flooring — Shur-Site Treads • Armorgrids Hydro Dehazers • Petrochemical Column Internals

#625

WE HEAR THAT

Continued from page 278

▶ Manufacturing and administrative facilities of *METTLER CO., INC., DIV. of ECLIPSE FUEL ENGINEERING CO.* have been moved from Los Angeles to Rockford, Ill.

▶ *VAN-PACKER CO., DIV. of FLINTKOTE CO.* moved on September 1 from its offices in Carbon Cliff, Ill., to new office facilities at Chicago Heights, Ill.

▶ Four-year college scholarships were given to two high school graduates residing in communities where *NATIONAL-U. S. RADIATOR CORP.* has manufacturing plants. The company has awarded the scholarships for the sixth consecutive year.

▶ *AIR DEVICES INC.* has acquired the complete line of registers and grilles formerly manufactured by *STEWART MFG. CO.*

▶ *PITTSBURGH PLATE GLASS CO.* will construct a glass fabricating plant on a 49 acre site at Crestline, Ohio. The factory is to be a one-story structure containing 275,000 sq ft of floor space and will employ 250 to 275 workers.

▶ Officials of Pacific Coast aviation and industrial firms joined civic leaders and city officials of Santa Monica, Calif. at the formal opening of the Pacific division of *TITEFLEX, INC.* on September 22.

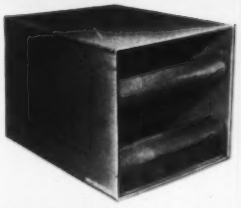
▶ Construction has begun on *AIR REDUCTION SALES CO.'s* new oxygen and nitrogen plant at Denver. The new plant is expected to be completed and in operation by January 1, 1959.

▶ A two-year heating and air conditioning course for technicians began September 15 at Los Angeles Trade-Technical Junior College. The course is sponsored by the *INSTITUTE OF HEATING AND AIR CONDITIONING INDUSTRIES.*

▶ *BRISK METAL PRODUCTS* has expanded its plant facilities for the third time in three years.

▶ *GORMAN-RUPP CO.* has been elected to membership in the accessory division of *OIL-HEAT INSTITUTE OF AMERICA.*

UNI-SILENCER* For AIR CONDITIONING and VENTILATING SYSTEMS

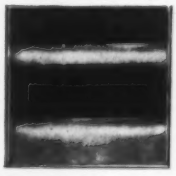


UNI-SILENCER* MODEL A
Moderate pressure drop, standard acoustical efficiency

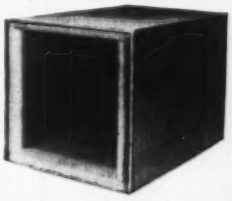
UNI-SILENCER* MODEL LPD
Lowest possible pressure drop, moderate acoustical efficiency

A full line of Elof Hansson silencers to effectively reduce airborne noise generated by fans in air conditioning, ventilating systems and by power roof ventilators. They are easily and conveniently installed in building structures at low cost due to new mass-production methods made possible by standardizing on modular sizes. Savings are of such proportions that UNI-SILENCER* prices compare favorably with conventional duct lining.

The performance of UNI-SILENCERS,* both as to acoustical attenuation and pressure loss have been tested and certified by independent, impartial outstanding authority. The certified data is guaranteed in writing and bonded. Free engineering service! Fill out and mail coupon for literature today!

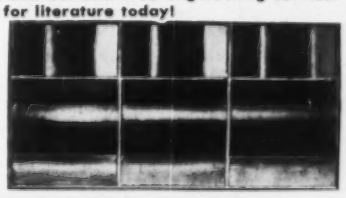


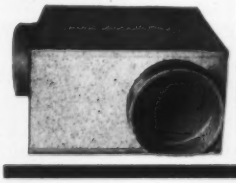
UNI-SILENCER* MODEL B
Higher pressure drop, maximum acoustical efficiency



UNI-RESONATOR* Low frequency duct silencer—used in series with UNI-SILENCERS*.

UNI-SILENCERS* are slip-joined in simple manner as with children's building blocks, to fit almost any conditions or requirements.





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Elbow silencer for ducts

E H ROOF VENTILATOR SILENCER for power roof ventilators

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MEETINGS & CONVENTIONS

1958

NOV. 6-7—*Galvanizers Committee of the Steel Industry*, 39th meeting. Pick-Roosevelt Hotel, Pittsburgh. Sponsored by American Zinc Institute, Inc., 60 E. 42nd St., New York 17.

NOV. 11-13—*National Association of Practical Refrigerating Engineers, Inc.*, annual meeting. Kenilworth Hotel, Miami Beach, Fla. National Association of Practical Refrigerating Engineers, Inc., 435 N. Waller Ave., Chicago 44.

NOV. 13-14—*Industrial Air Conditioning Institute.* University of Wisconsin, Madison, Wis. Information: R. L. Loetscher, Engineering Institute, University of Wisconsin, Madison, Wis.

NOV. 17-21—*Society of the Plastics Industry, Inc.*, eighth National Plastics Exposition. International Amphitheater, Chicago. To be held concurrently with the SPI annual national conference, Morrison Hotel, Chicago. SPI headquarters: 250 Park Ave., New York.

NOV. 18-20—*National Conference on Air Pollution*, Sheraton Park Hotel, Washington, D.C. Information: U.S. Public Health Dept., Washington, D.C.

NOV. 18-20—*American Standards Association*, meeting and conference on standards. Roosevelt Hotel, New York. American Standards Association, 70 E. 45th St., New York.

DEC. 1—*American Society of Heating and Air-Conditioning Engineers*, special meeting. Conrad-Hilton Hotel, Chicago. ASHAE headquarters: 62 Worth St., New York 13.

DEC. 1-3—*American Society of Refrigerating Engineers*, semi-annual meeting. Roosevelt Hotel, New Orleans, La. American Society of Refrigerating Engineers, 234 Fifth Ave., New York 1.

DEC. 1-5—*American Society of Mechanical Engineers*, national exposition of power and mechanical engineering. New York Coliseum, New York. Information: International Exposition Co., 480 Lexington Ave., New York 17.

DEC. 3-4—*Building Research Institute*, special meeting on field applied paints and protective coat-

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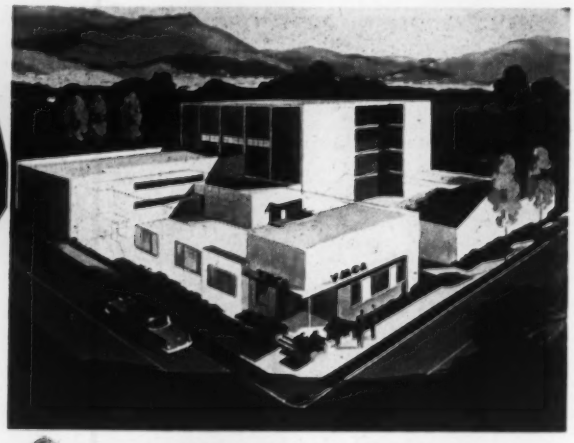

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Thermal is proved equipment, specified with confidence that it will produce the utmost in performance and dependability. Write for detailed specifications.

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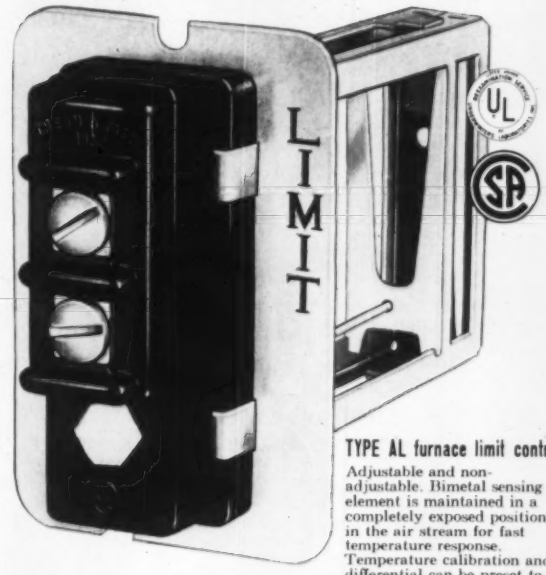

TYPE AL furnace limit control

Adjustable and non-adjustable. Bimetal sensing element is maintained in a completely exposed position in the air stream for fast temperature response. Temperature calibration and differential can be preset to your specifications up to 300° F. Standard factory differential is 25° F. Can be supplied with a closer or wider differential on request. Adjustable feature at no extra cost. Standard range of adjustment is 90° F. 40° F. range also available. Furnished with either 3-inch (AL-3) or 7-inch (AL-7) probe.

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Corrosion-resistant,
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MEETINGS & CONVENTIONS

Continued

1958

ings. Building Research Institute, National Academy of Sciences—National Research Council, 2101 Constitution Ave., Washington 25, D.C.

DEC. 4-5—National Warm Air Heating and Air Conditioning Association, 45th annual convention. Statler Hilton Hotel, Cleveland, Ohio. Association headquarters: 640 Engineers Bldg., Cleveland 14.

DEC. 8-10—American Nuclear Society, 1958 annual meeting. Sheraton-Cadillac Hotel, Detroit. National headquarters: American Nuclear Society, Chicago 1.

1959

JAN. 14-15—Building Research Institute, conference on noise control in buildings. Hotel New Yorker, New York City. Building Research Institute, National Academy of Sciences—National Research Council, 2101 Constitution Ave., Washington 25, D.C.

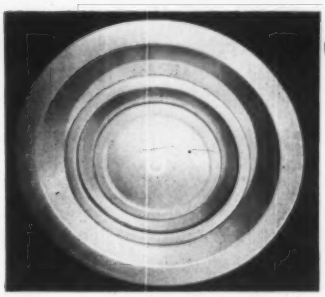
JAN. 19-20—Industrial Heating Equipment Association, Inc., meeting. Cleveland, Ohio. IHEA headquarters: 1145 19th, N.W., Washington 6, D. C.

JAN. 26-29—Plant Maintenance and Engineering Show and Conference. Cleveland Public Auditorium. Cleveland, Ohio. For information, contact: Clapp & Poliak, Inc., 341 Madison Ave., New York 17.

JAN. 26-29—14th International Heating and Air-Conditioning Exposition. Philadelphia. Under auspices of the American Society of Heating and Air-Conditioning Engineers, in conjunction with its 65th annual meeting, also in Philadelphia. Exposition management: International Exposition Co., 480 Lexington Ave., New York 17. ASHAE headquarters: 62 Worth St., New York 13.

FEB. 3-5—Society of the Plastics Industry, Inc., 14th SPI reinforced plastics division conference. Edgewater Beach Hotel, Chicago. SPI headquarters: 250 Park Ave., New York 17.

MAR. 16-20—National Association of Corrosion Engineers, 1959 Corrosion Show and 15th annual conference. Sherman Hotel, Chicago. National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.



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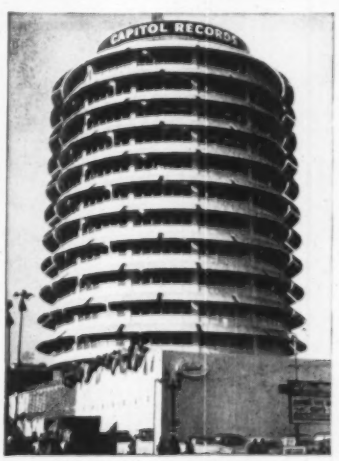

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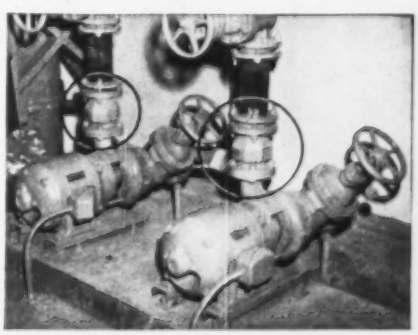

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MEETINGS & CONVENTIONS

Continued

1959

MARCH 31-APRIL 2—American Power Conference, sponsored by Illinois Institute of Technology in cooperation with a group of technical societies and other educational institutions. Hotel Sherman, Chicago. Information: R. A. Budenholzer, Mechanical Engineering Dept., Illinois Institute of Technology, 3300 Federal St., Chicago 16.

APRIL 1-3—Gas Appliance Manufacturers Association, annual meeting. The Greenbrier, White Sulphur Springs, W. Va. GAMA headquarters: 60 E. 42nd St., New York 17.

APRIL 5-9—Nuclear Congress. Cleveland Auditorium, Cleveland. Information: Engineers Joint Council, 29 W. 39th St., New York 18.

APRIL 6-10—International Atomic Exposition, sponsored by Atomic Industrial Forum, Inc. Cleveland. Information: H. F. Grebe, exhibits manager, International Atomic Exposition, Architects Bldg., Philadelphia 3.

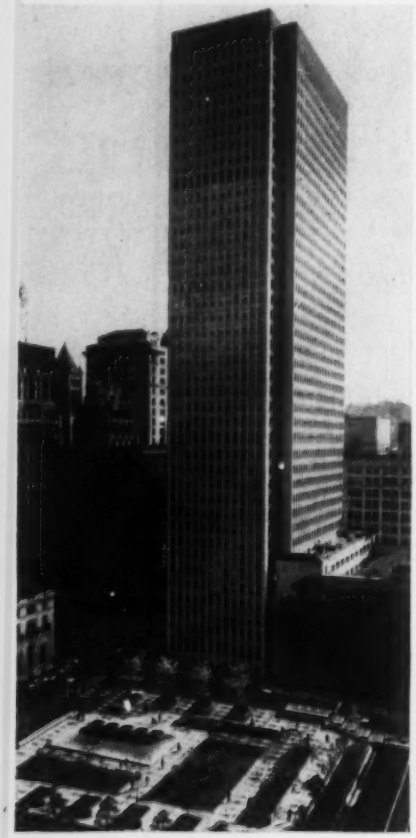
APRIL 28-MAY 1—Mechanical Contractors Association of America, 70th annual convention. Shoreham Hotel, Washington, D. C. MCAA headquarters: 45 Rockefeller Plaza, Suite 570, New York 20.

APRIL 29-MAY 4—Oil-Heat Institute of America, Inc., annual convention. Seattle, Wash. Oil-Heat Institute of America, Inc., 500 Fifth Ave., New York 36.

MAY 17-20—Industrial Heating Equipment Association, meeting. The Homestead, Hot Springs, Va. Industrial Heating Equipment Association, Inc., 1145 19th, N. Y. Washington 6, D. C.

JUNE 7-11—American Society of Heating and Air-Conditioning Engineers, semi-annual meeting. Vancouver, B. C., Can. ASHAE headquarters: 60 Worth St., New York 13.

SEPT. 21-25—Instrument Society of America, instrument-automation conference and exhibit. International Amphitheater, Chicago. For information contact: Fred J. Tabery, exhibit manager, Instrument-Automation Conference and Exhibit, 3443 S. Hill St., Los Angeles 7. ∓



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THE PLANT: 42-story office building at 525 William Penn Place, Pittsburgh. Hot-chilled water circulating systems contain steel risers, copper runouts, brass automatic valves; air condition 13,500,000 cubic feet of office space; circulate 14,000 gallons of water.

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Steel:	0.010
Copper:	0.004
Brass:	0.008

FOR FULL INFORMATION on how economical Hagan Corrosion Inhibitor CS can help keep your closed water system corrosion free, write for Bulletin 410-12-3.

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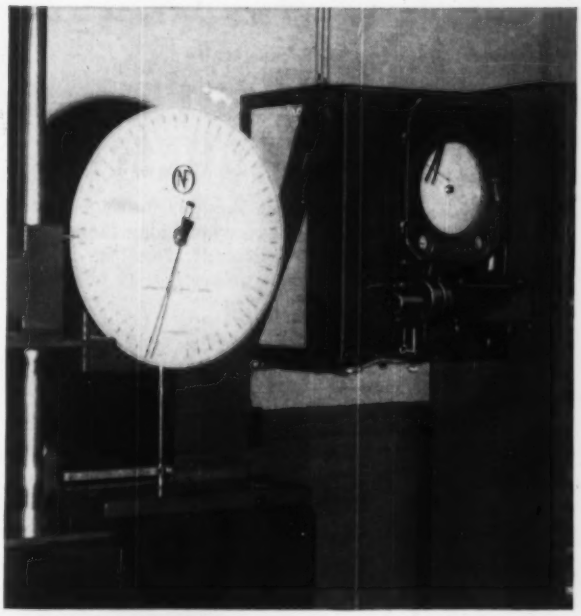

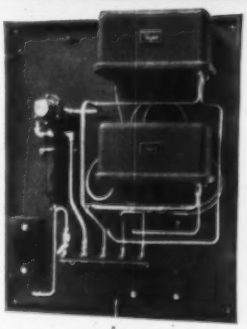

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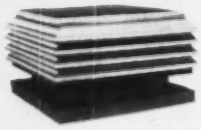

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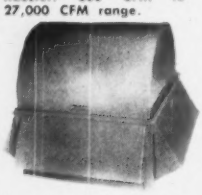
Air Mover Belt drive centrifugal power roof exhauster. 300 CFM to 27,000 CFM range.



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NEW BOOKS & REPORTS...

CENTRIFUGAL AND AXIAL FLOW PUMPS, THEORY, DESIGN AND APPLICATION, SECOND EDITION—By A. J. Stepanoff. 462 pp. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. $12.00.

NATIONAL FIRE CODES, 1958, SIX VOLUMES—Volume I, Flammable Liquids and Gases; Volume II, Combustible Solids, Dusts, Chemicals and Explosives; Volume III, Building Construction and Equipment; Volume IV, Extinguishing Equipment; Volume V, Electrical Equipment; Volume VI, Transportation and Miscellaneous items. 4800 pp. National Fire Protection Association, 60 Batterymarch St., Boston 10. $7.00 per volume.

SUMMER AIR CONDITIONING—By Seichi Konzo, J. Raymond Carroll and Harlan D. Bareither. 554 pp. Windsor Press, 200 E. Ontario St., Chicago 11. $7.50.

PROCEEDINGS OF THE NATIONAL DISTRICT HEATING ASSOCIATION, 1957. 224 pp. National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6. $7.50.

YOUR MOST IMPORTANT RAW MATERIAL—By Everett P. Partridge. 27 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3. $1.25.

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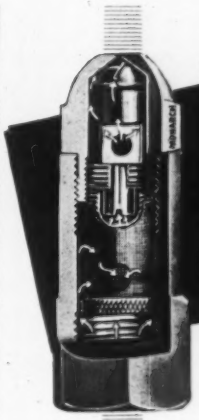

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Canadian Agents: (Except B. C.)
E. S. Gallagher Sales Ltd., Toronto 12, Canada

Statement of Ownership and Management of
HEATING, PIPING & AIR CONDITIONING

for October 1, 1958

The following is a statement of ownership, management, etc., as required by the act of Congress of August 24, 1912, as amended by the acts of March 3, 1933 and July 2, 1946 (Title 39, United States Code, Section 233) of Heating, Piping & Air Conditioning, published monthly at Chicago, Ill., for October 1, 1958:

1. The names and addresses of the publisher, editorial director, editor, and president are:

Publisher, Chas. E. Price, Glencoe, Illinois.
Editorial Director, C. M. Burnam, Jr., Chicago, Illinois.
Editor, Robert W. Roose, LaGrange, Illinois.
President, Chas. E. Price, Glencoe, Illinois.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.)

Keeney Publishing Company, 6 North Michigan Avenue, Chicago 2, Illinois. Stockholders: W. J. Osborn, Fairfield, Connecticut; Chas. E. Price, Glencoe, Illinois; Robert A. Jack, Cleveland Heights, Ohio.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

Chas. E. Price, President

Sworn to and subscribed before me this 16th day of September, 1958.

Lydia Thomas.
(SEAL) {My commission expires November 22, 1959}

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NEMA STANDARDS PUBLICATION FOR INDUSTRIAL HEATING UNITS AND DEVICES, HU 1-1958. National Electrical Manufacturers Association, 155 E. 44th St., New York 17. 20c.

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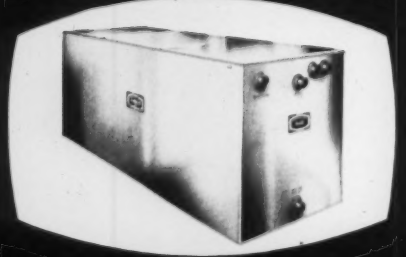

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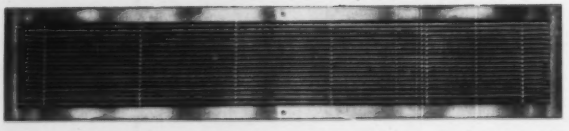

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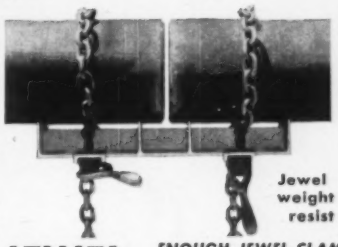

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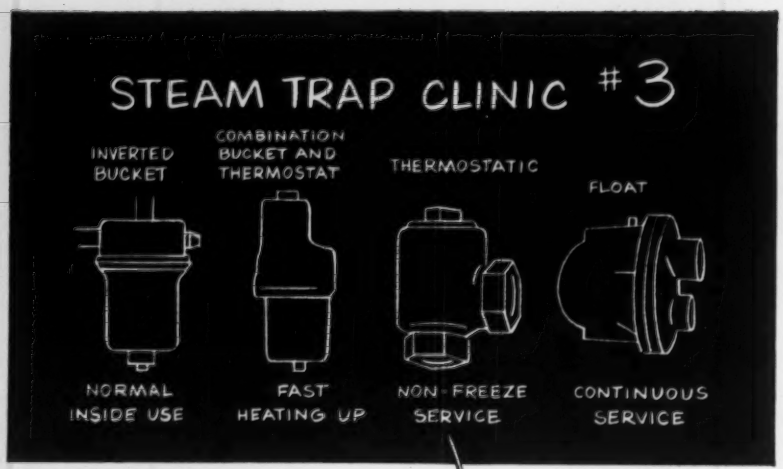

Which design of trap is best?

You can increase the heat from steam units as much as 35% by careful selection of the right design of trap. For example, although inverted bucket traps are best for most normal indoor uses, a combination open float and thermostatic trap permits steam units to reach maximum heat 2½ times faster.

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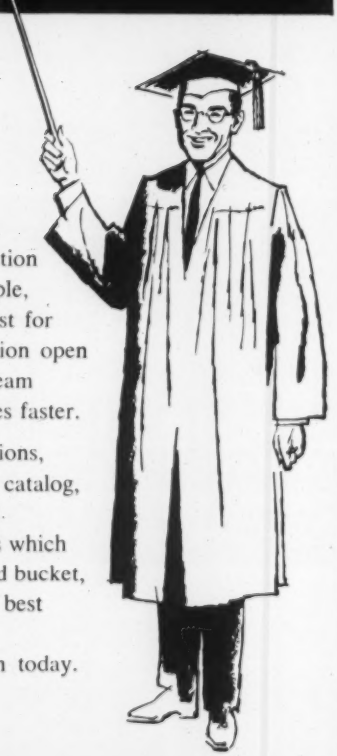

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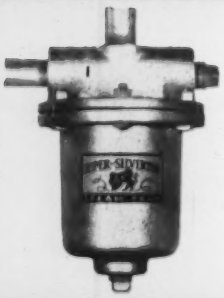

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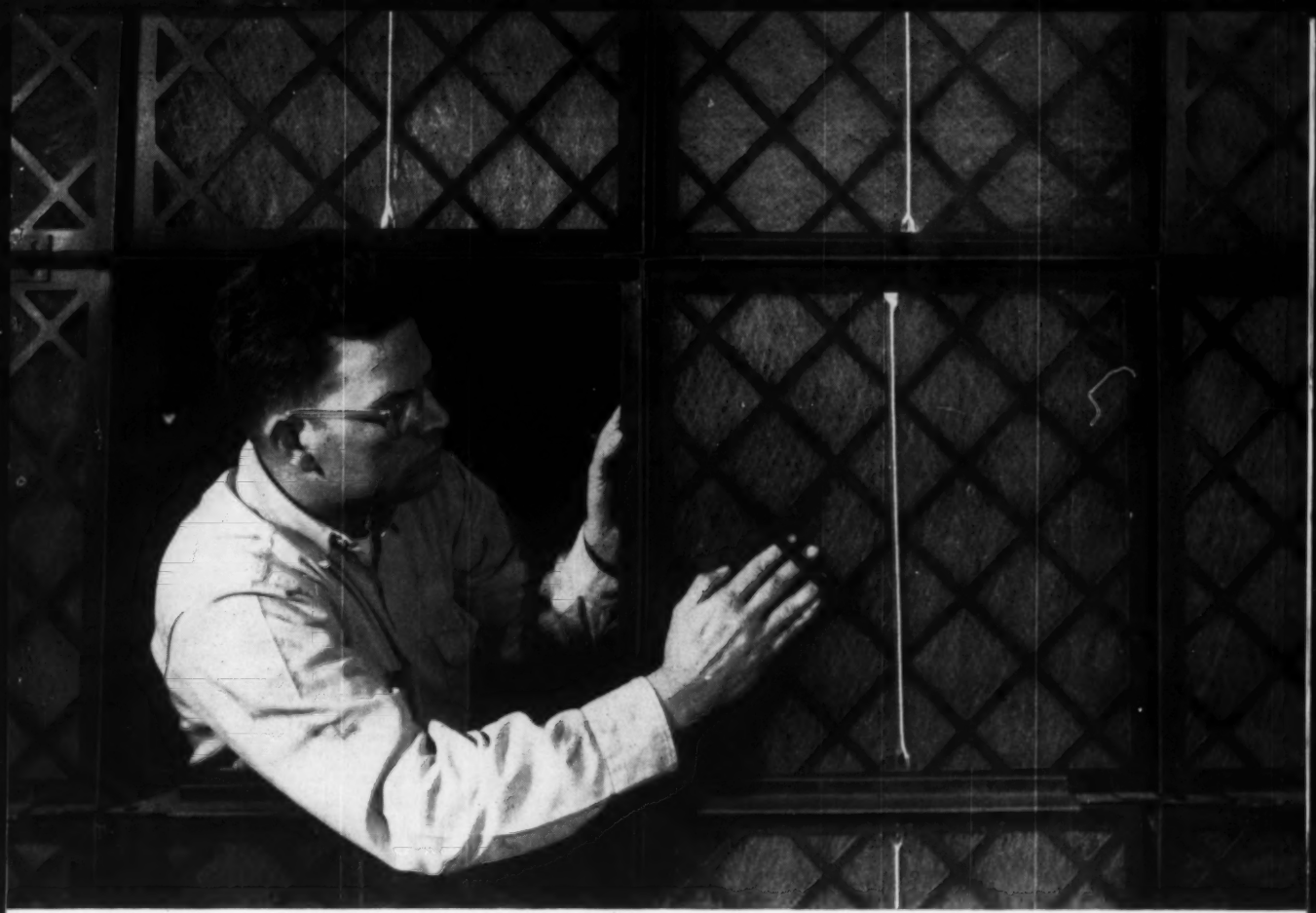

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"With the older type metal grille filters previously used, we experienced frequent blow-outs. Air is drawn through the filter bank at a high velocity; but since switching to Glasfloss Safety-Grille filters, the blow-out problem has been eliminated.

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Hallmark of Circulation Value

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MARSH PACKLESS RADIATOR VALVES

WHEEL HANDLE

GRADUATED

LOCK AND SHIELD

ANGLE PATTERN

GLOBE PATTERN

CORNER PATTERN (Sectional Below)

MARSH THERMOSTATIC RADIATOR TRAPS

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STRAIGHTWAY PATTERN

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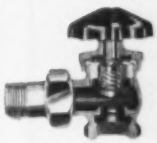
LEFT HAND CORNER PATTERN

RIGHT HAND CORNER PATTERN



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Marsh Instrument & Valve Co. (Canada) Ltd.
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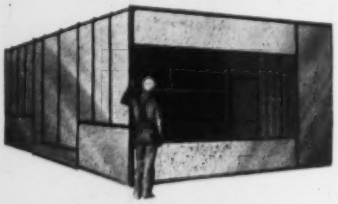

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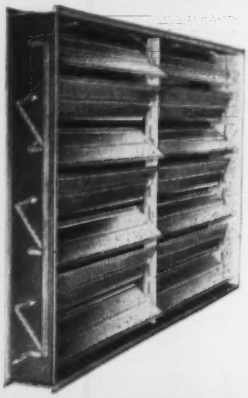

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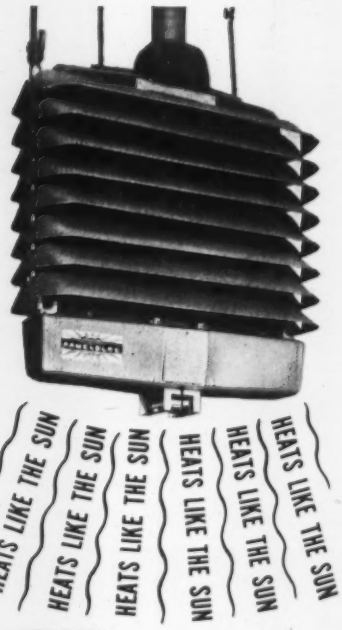

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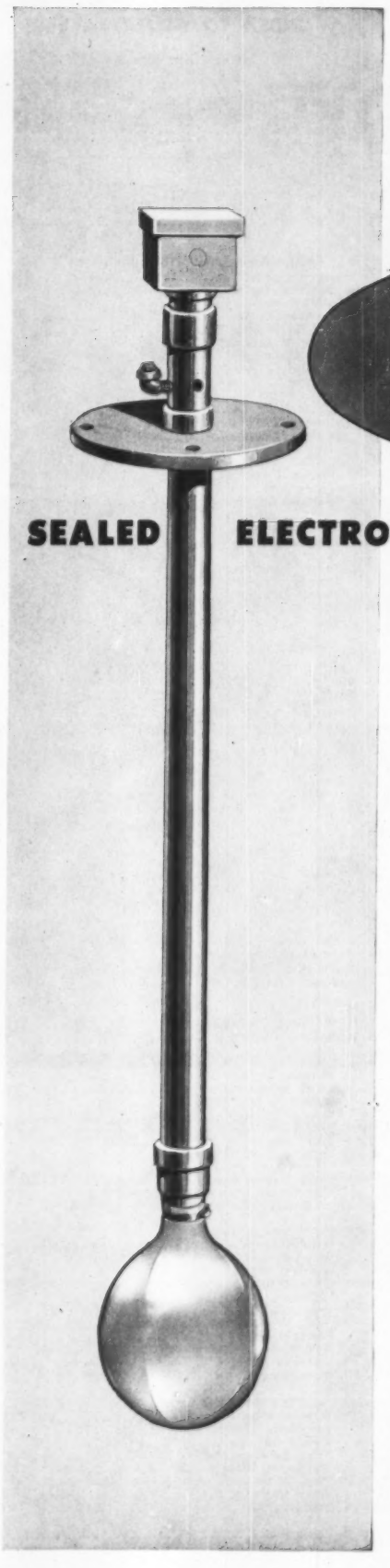

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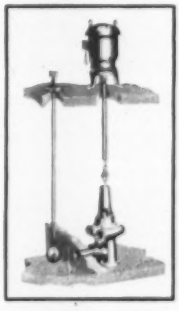

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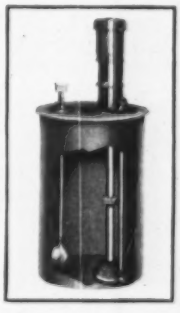

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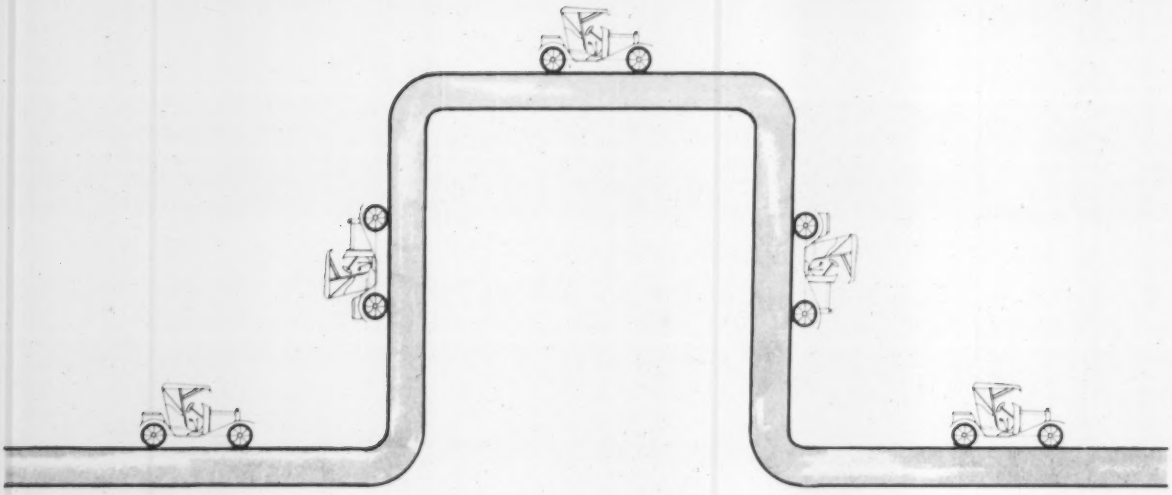

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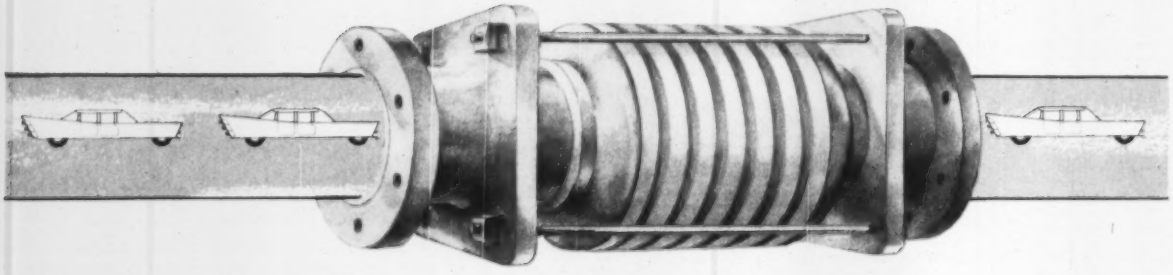

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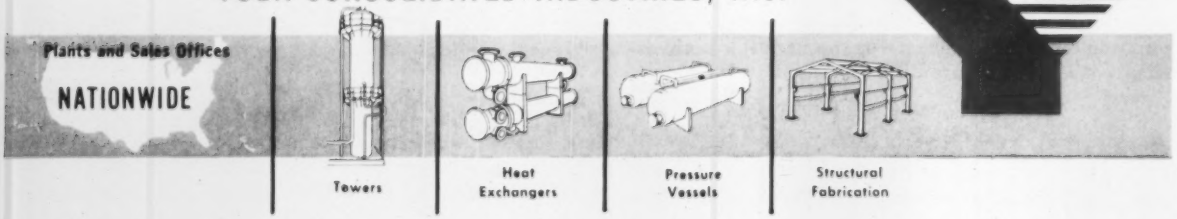

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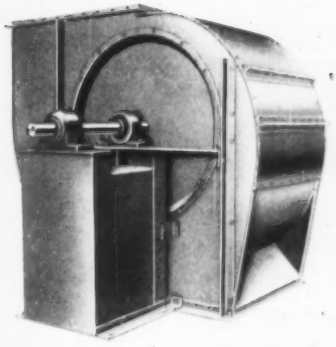

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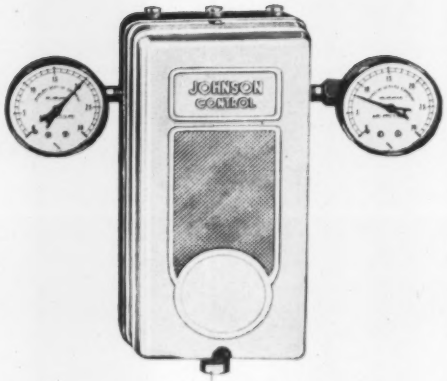

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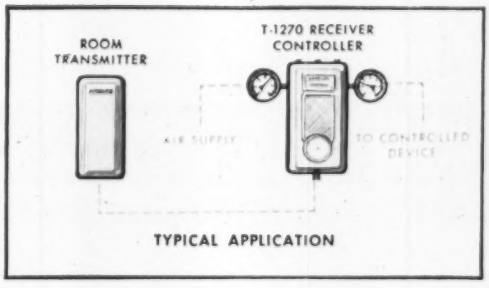

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